Heating Piping & Air Conditioning

DESIGN
INSTALLATION
OPERATION
MAINTENANCE

DECEMBER ★ 1950

INDUSTRIAL
COMMERCIAL
INSTITUTIONAL AND
PUBLIC BUILDINGS

ıge 109—Journal Section of the American Society of Heating and Ventilating Engineers

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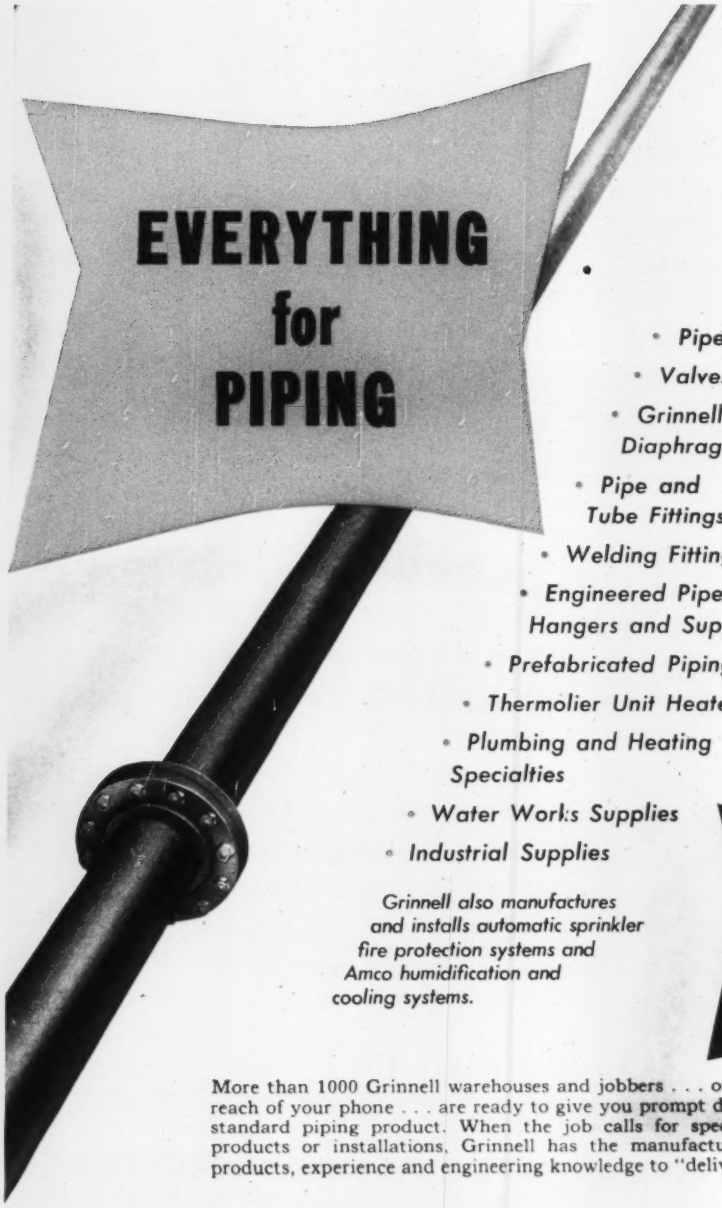

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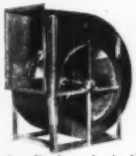
Tools of Air Conditioning

JOB IDEAS BY usAIRco

BLOWERS

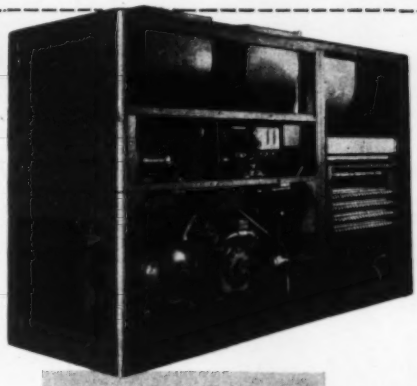
for Industrial and Commercial Use

TYPE FC. For ventilating or exhaust duty. Forward curved blade type built in single and double inlet models with standard discharge arrangements . . . Bulletin No. 440



TYPE A. Backward inclined blade blowers. Generally specified for higher pressures and non-overloading characteristics. Suitable for direct motor connection . . . Bulletin No. 440

TYPE CH. Single inlet, single width forward curved blade blower. Assembled as completely weather-proofed housed ventilating set. Use indoors or outdoors . . . Bulletin No. 52



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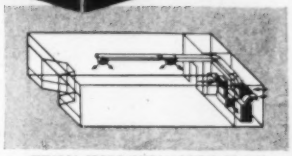
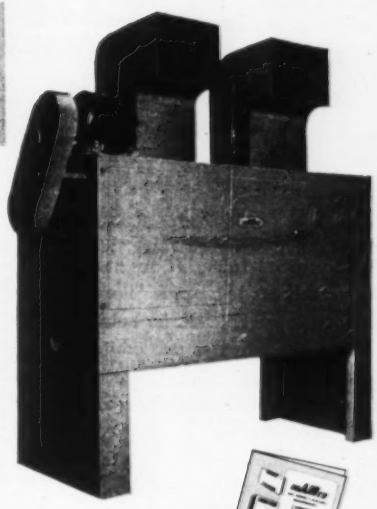


TYPICAL STORE INSTALLATION OF R-K



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Designed for wide application in factories, warehouses, garages. Can be used in any one of four positions: for floor, ceiling, inverted or wall mounting. Units built in sections for easy handling, installation, maintenance. Available with standard steam or steam distributing tube coils in any one of five capacity sizes. Standard unit consists of blower section, coil section and accessories as required including filters, mixing chambers and face and by-pass dampers. Built in eight sizes from 37,500 Btu to 1,995,000 Btu per hour.

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to install pipe

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The original installation had been quickly made by pipe fitters. But the replacement calls for hours of work by as many as five crafts: pipe fitter, mason, plasterer, carpenter, painter. And this is only part of the cost story. The loss in production or utilization during the shut-down may amount to far more than the maintenance charge.

True, you pay a little more to *begin* with for Byers Wrought Iron pipe . . . but you pay a lot less to *end* with. In literally thousands of applications where corrosion costs you more than wrought iron, the use of this material is the soundest kind of economy move.

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This notch-fracture test specimen illustrates the unusual fibrous structure of wrought iron—which is responsible for the unusual corrosion resistance of the material. Tiny threads of glass-like silicate slag, distributed through the body of high-purity iron, halt and disperse corrosive attack, and discourage pitting and penetration. They also anchor the initial protective scale, which shields the underlying metal.

You will find a lot of helpful information on the control of excessive maintenance through the use of Byers Wrought Iron pipe in our technical bulletin, WROUGHT IRON FOR PIPING SYSTEMS. We will be glad to send you a copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco, Export Division: New York, New York.

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ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

Heating Piping & Air Conditioning

(with which is merged the Aerologist)

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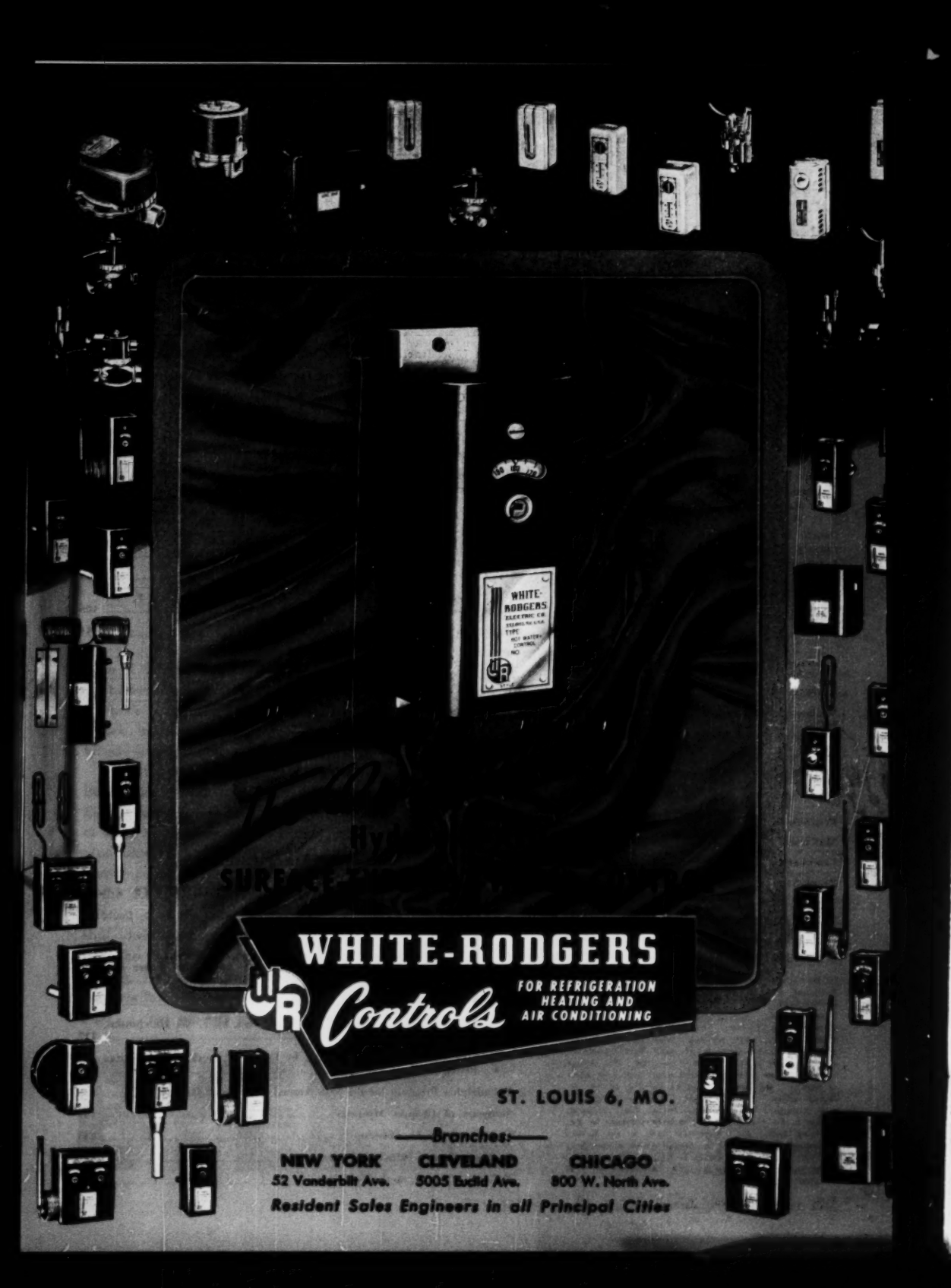
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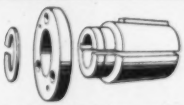

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Bushing split full length with separate collar. Grips shaft full length around full diameter. No forcing or distortion. Grip easily broken. No hammering.

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Magic Grip sheaves are available from 3" pitch diameter up. Style NC bushing for smaller sizes and Style C bushing for larger sizes.

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50 YEAR report to our customers -

FROM DATE OF INCORPORATION ON NOVEMBER 23, 1900 TO DECEMBER 31, 1949

THE COMPANY RECEIVED:			
From customers for products purchased by them		$5,122,702,261	
Dividends received, interest earned, and other income		76,068,236	
Total revenues		$5,198,770,497	
THE COMPANY PAID OUT OR PROVIDED:			
For raw materials, supplies, and services bought	$2,766,354,971		
Provision for depreciation (wear and tear or obsolescence) of plants, buildings, machinery and equipment and for depletion of coal, iron ore and limestone, etc., by mining operations	270,852,769		
Federal, State, local and miscellaneous taxes	267,462,953		
Interest and other costs on long-term debt (including dividends of $27,265,805 paid to preferred shareholders)	117,724,128		
Total costs		3,422,394,821	
Leaving for wages and salaries of employees, dividends to shareholders, and amount required to be retained by company for needs of the business		*$1,776,375,676	100.00%
***OUT OF WHICH THERE WAS PAID:**			
Employment costs (pay rolls, vacations, social security taxes, insurance and pensions paid to or for account of employees)		$1,474,693,687	83.02%
To common shareholders as dividends		125,126,950	7.04
Amount retained in the business for present and future needs and to assure steady work for employees		176,555,039	9.94
Total		$1,776,375,676	100.00%

Your patronage and the American system of free enterprise have helped make this company an important factor in the steel industry. Our future depends on keeping America free, so that any group of citizens may organize a business, at any time--with the expectation that it, too, may grow strong--provide jobs, supply needed products and achieve success in the next 50 years. In the preservation of the American way of life lies our future hope.

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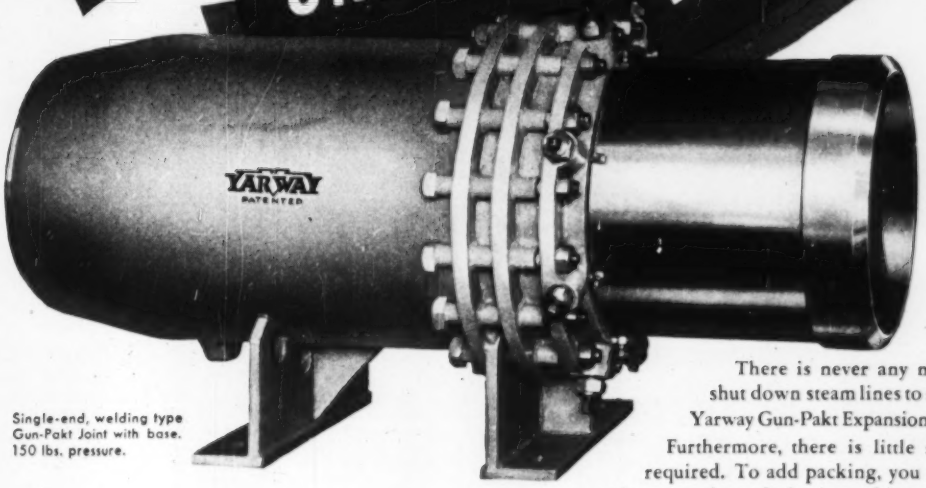
THIS EXPANSION JOINT IS SERVICED UNDER FULL STEAM PRESSURE



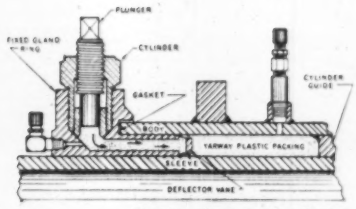
Single-end, welding type Gun-Pakt Joint with base. 150 lbs. pressure.

There is never any need to shut down steam lines to service Yarway Gun-Pakt Expansion Joints. Furthermore, there is little service required. To add packing, you simply insert a plug of plastic packing, turn a wrench, and the job's done! Special Alemite fittings provide for proper lubrication.

Maintenance costs are trifling. One large user reports 65 cents per year per joint. Others claim less than that.

Gun-Pakt Joints are available with single or double-ends, welding or flanged types, in sizes from 2" to 30", with traverses from 4" to 24", and for pressures to 400 psi.

For the full Gun-Pakt story, write for Yarway Bulletin EJ-1912.



Close-up of cross-section showing detail of Gun-Pakt feature.

YARNALL-WARING COMPANY
107 Mermaid Avenue, Philadelphia 18, Pa.

YARWAY GUN-PAKT EXPANSION JOINT

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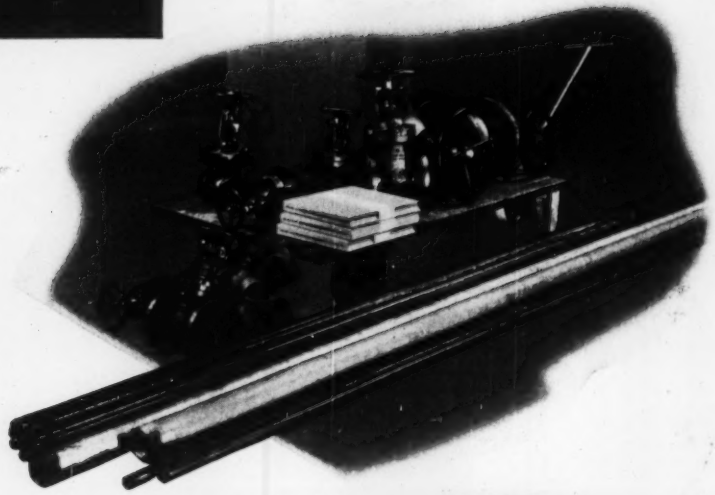

Your Spang CW Pipe Distributor carries the things you want! A complete line of piping materials—a real desire to render fast, complete service.

One of the many complete lines he carries is Spang CW Pipe in black and galvanized finishes, all standard sizes, and convenient uniform lengths. Threads, dimensions, inside and outside surfaces are subjected to rigid inspection, and each length is hydrostatically tested to assure a strong, tight longitudinal weld from end to end.

Next time you need pipe, fittings, fixtures, valves, or other piping material, call your Spang Distributor. During these days of short supply he may not be able to fill your order immediately, but you can depend on him to do everything possible to meet your demands.

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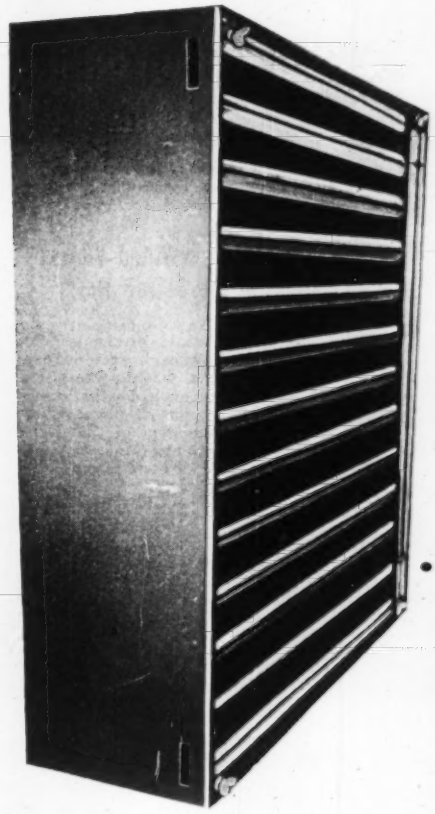

We sell "C" cells

...that materially reduce the cost of air conditioning

The picture shows a Dorex Type C Air Recovery Cell. In an air conditioning system or unit, it purifies the air, improves ventilation, saves cooling and heating costs by reducing necessary intake of new, outside air as much as two-thirds.

Notice the "accordion pleats." They contain Dorex *Activated* Carbon. As used air flows through the "C" Cell, this special carbon extracts and retains all odorous, vaporous and gaseous impurities—just as a gas mask would. Stale air is purified, made fresh and completely reusable.

A double saving results from the use of Dorex Type C Air Recovery Cells. (1) Initial air conditioning equipment costs are less because, obviously, less heating and cooling capacity will be required. (2) Operating costs come down—because it costs only about half as much to freshen used air as to condition new air.

Dorex Air Recovery has proved its effectiveness in more than 6,000 installations over the past 20 years. If you do not have complete information in your files on how Dorex works, who uses it, and its great advantages to you and your clients—let us send it to you. Just mail the coupon below.

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WORTHINGTON AIR CONDITIONING REPORT

WORTHINGTON PUMP AND MACHINERY CORPORATION
HARRISON, NEW JERSEY

Specialists in air conditioning and refrigeration for more than 50 years

Worthington Air-Conditions a "Jungle"

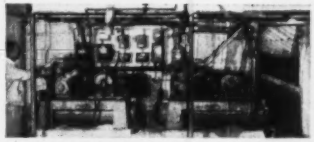
There is no such thing in the field of professional orchidology as a "Topsy" orchid. No prize beauty ever "jest grew." It takes large measures of patience, love and the nation's best horticultural brains to raise an orchid properly. At McKee Jungle Gardens, Vero Beach, Florida, one of the South's leading departments of orchidology under the direction of David C. Fairburn, PhD., has added air conditioning to the list of requirements for advanced orchid culture.

Rare hybrid orchids must be planted in flasks of sterile food solution under carefully controlled conditions. At McKee Jungle Gardens, Worthington air-conditioning equipment provides precise temperature and humidity requirements for this delicate operation.

Properly controlled interior climatic conditions are the secret of successful development of orchid seedlings. The Worthington air-conditioning plant at McKee Jungle Gardens assures temperatures accurate to a fraction of a degree.

Arthur G. McKee, owner of the project, has raised many uncommon hybrid orchids in greenhouses, developing new strains under controlled temperatures. Some of these have been developed to the point at which they withstand outdoor temperatures and may live year-'round in outside locations throughout the 80-acre Jungle Gardens area. But many rare strains of orchids spend their entire lives—and it takes an average of seven years for an orchid to mature—breathing conditioned air indoors.

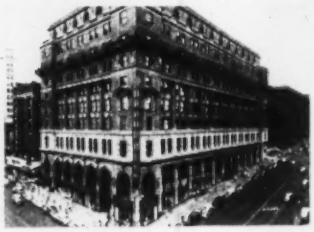
At Vero Beach a large fortune in orchids is depending on Worthington air conditioning units. Perhaps the



Worthington Freon-12 condensing units and AHY air conditioning units at McKee Jungle Gardens

greatest single triumph for Worthington and McKee Jungle Gardens has been the successful raising of the ultra-rare Odontoglossum orchids. These are spray orchids native to 15,000 foot altitudes and low temperatures of the Andes Mountains in South America. Attempts to grow these orchids in the South—and in many parts of the North—have ended in dismal failure because the plants could not withstand radically hot summer temperatures. At McKee Jungle Gardens the Odontoglossums are living in a Worthington-made mountain atmosphere that has not only encouraged their healthy growth, but has also aided several complicated hybridizations. Future plans for the Odontoglossum call for a process of "air-conditioning the plants back to the outdoors," a process in which, through scientifically-plotted temperature changes, the plants can be made to adapt themselves to the normal outdoor climate of Florida and other southern states.

Another Big Store is Worthington-Conditioned



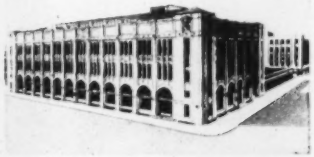
J. L. Brandeis & Sons, Omaha, has installed a Worthington 67C9S centrifugal refrigeration system (647 ton capacity) for air conditioning the lower floors of this store building.

Engineering by Charles S. Leopold Company

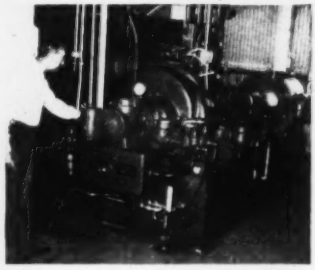
No More "Wilted Violets" at the Detroit News

"I am sure it's a wonderful investment for efficiency and production. You should see how bright-eyed and happy the staff looks, whereas the last hot day we were a bunch of wilted violets."

That is a typical comment received by the management of The Detroit News shortly after installation of Worthington air conditioning.



The Detroit News—publisher of the newspaper with the largest ABC-recognized home-delivered circulation in the country.



Worthington centrifugal compressor with condenser and cooler in Detroit News building.

Every minute 240,000 cubic feet of cooled, freshened air is delivered throughout the building to air condition offices, press room and composing room. In the latter two rooms, humidity is carefully controlled, kept low in the composing room, and higher in the press rooms due to static electricity.

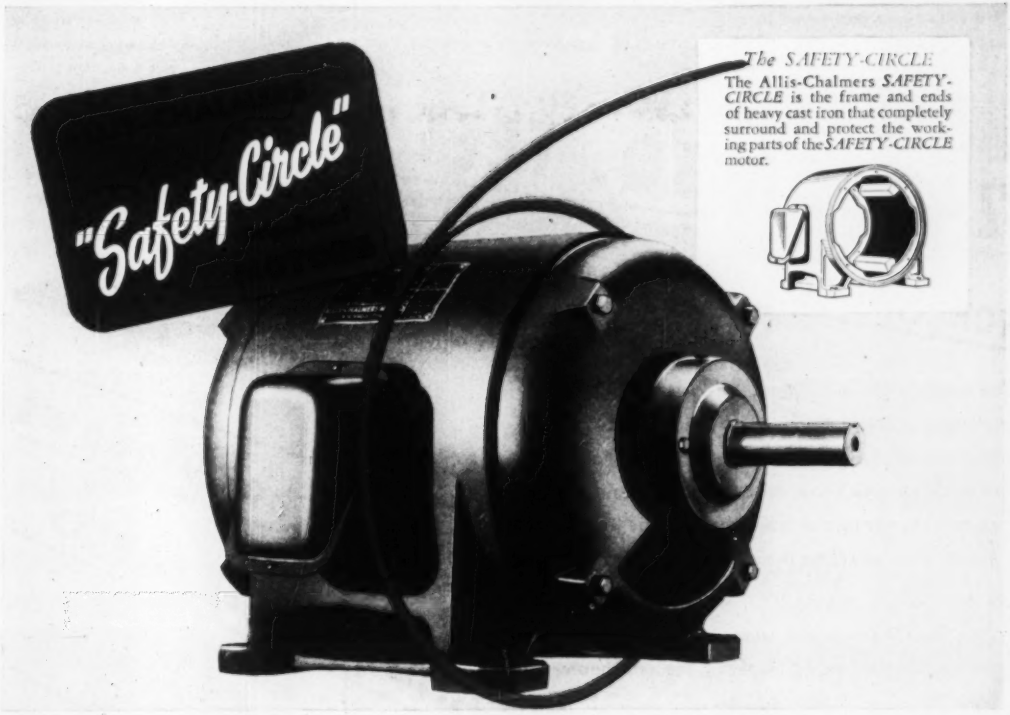
Source of the cooling is two Worthington centrifugal compressors, of 200 and 250 ton capacity.

Other Worthington equipment in the installation includes two coolers and condensers and water pumps.

WORTHINGTON

AIR CONDITIONING AND REFRIGERATION

A complete line . . . in which *all* the vital components are made, not just assembled by Worthington. For more worth with Worthington, see your nearby Worthington distributor (consult Classified Telephone Directory).



The SAFETY-CIRCLE

The Allis-Chalmers *SAFETY-CIRCLE* is the frame and ends of heavy cast iron that completely surround and protect the working parts of the *SAFETY-CIRCLE* motor.

SAFETY-CIRCLE means

★ All-Around Protection ★ Low Maintenance ★ Dependable Performance

A-3144

THE *SAFETY-CIRCLE* MOTOR is protected all around against those four great motor killers — corrosion . . . distortion . . . friction . . . foreign matter. The frame is of cast iron, the most corrosion-resistant material for this purpose.

The strength and stiffness of the cast iron is supplemented by ribbing and bracing to maintain alignment and prevent distortion. Ball bearings are lubricated and sealed at the factory. They require no attention for years. End brackets are drip-proof at no premium.

SAFETY-CIRCLE motors are fully protected inside, too. Multiple-dipped and multiple-baked stator plus extra inter-phase insulation provide extra protection against electrical breakdown.

With *SAFETY-CIRCLE* protection outside and protected working parts inside, you can count on years of trouble-free, low cost power.

For complete details on *SAFETY-CIRCLE* advantages, see your A-C Authorized Dealer or Sales Office or write for Bulletin 51B6210B. Stocked in sizes 1 to 20 hp. *SAFETY-CIRCLE*, *Texrope* and *Vari-Pitch* are Allis-Chalmers trademarks.

ALLIS-CHALMERS, 1171A SO. 70 ST.
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CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE — Belts in all sizes and sections, standard and Vari-Pitch sheaves, speed changers.

PUMPS — Integral motor and coupled types. Sizes and ratings to 2500 GPM.

247,500 SQ. FEET AREA FOR CARRIER

Structural Design by Lockwood Greene & Co., New York, Architects & Engineers

Heating Designed and Installed by Carrier Corporation.

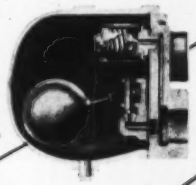
The engineers who designed the new Carrier Plant at Syracuse, New York, didn't just call up somebody and say "send us some steam traps." For they are the men who know air conditioning and heating, and the savings or losses that may be built into a plant when selecting the steam accessories.

So this Plant is ALL-SARCO—with the well known Sarco float-thermostatic steam traps for heating coils and Sarco bucket traps for the unit heaters.

And for permanent insurance against failures due to foreign material in their steam and water lines, more than 100 Sarco strainers ranging in sizes from ¾" to 3" are inserted at vital points all over the plant.

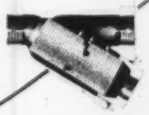
Sarco is not interested in just "selling some more steam traps." Whether you are building new plants, additions, or modernizing old heating systems, you will find that the Sarco Representative near you is interested in finding the right combination of steam traps and temperature controls that will give maximum heating comfort for your workers at less fuel costs. A phone call will bring you his experience with no obligations.

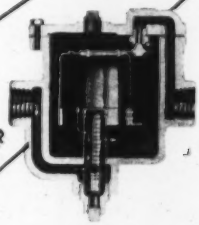
...with no windows AND IT'S ALL-SARCO



FLOAT-THERMOSTATIC STEAM TRAP

PIPE LINE STRAINER





BUCKET STEAM TRAP

331

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IMPROVES PRODUCT QUALITY AND OUTPUT

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Design for Permanence and LOW PRODUCT COSTS

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AVAILABLE IN SHAPES, SIZES AND GAUGES TO MEET YOUR NEEDS

FOR PERMANENCE . . . Hussey Copper and Brass are the *ageless* metals. With unmatched corrosion resistance as a basic physical characteristic, these metals retain their original beauty for the lifetime of your product.

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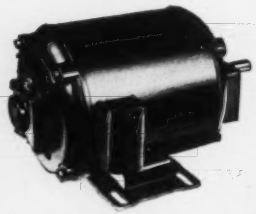
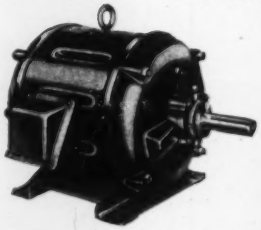
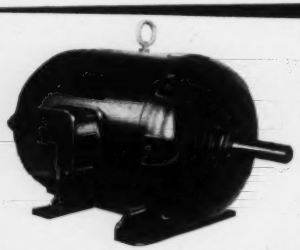


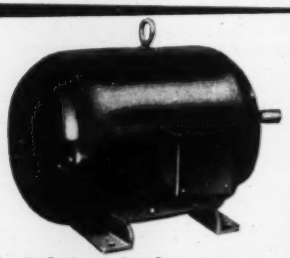
Repulsion-start Induction Motors... preferred for every single phase motor application. ⅛ to 15 hp.



Open-type Polyphase Squirrel Cage Motors... steel frame—sleeve or ball bearing. ⅛ to 400 hp.



Explosion-Proof, Totally-Enclosed, Fan-Cooled Motors... for use in hazardous locations. ½ to 200 hp.



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STEP AHEAD OF COMPETITION!

...STANDARDIZE ON WAGNER MOTORS

You add a sure selling point to your product when you choose a Wagner Motor to provide always dependable power! The wide range of types and sizes of Wagner Motors permits the selection of a standard motor for practically every requirement. Their high quality and steadfast dependability have made them the standard of many leaders in industry, who have gained a competitive advantage through this choice. If you need motors that will give a minimum of trouble in the field to help *you* step ahead of competition... choose Wagner Motors.

Thirty-one branch offices, located in principal cities are ready to help you. Bulletin MU-185 gives full information on the complete line of Wagner Motors.

YOU'LL SAVE TIME, MONEY, WORRY...BECAUSE

★ Wagner Motors are immediately available from Wagner Branches in principal cities.

★ Improved engineering features assure long life and efficient operation.

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★ More than 450 Wagner Authorized Service Stations and Parts Distributors plus 25 Wagner-owned Service Branches provide motors, on-the-spot service, and genuine repair parts.

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AUTOMOTIVE BRAKE SYSTEMS — AIR AND HYDRAULIC

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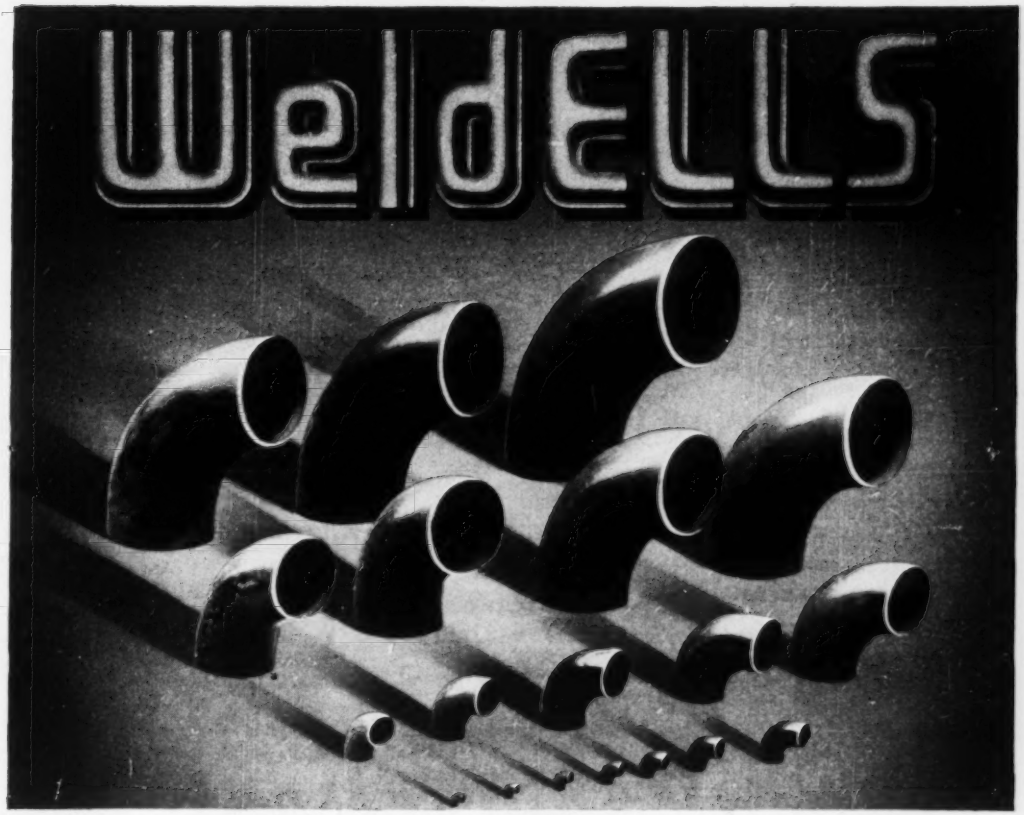
MU-185



Family Group ... *proud of its size ... and traditions*

Large group though it is, you see here only one branch of the world's largest family of fittings for pipe welding.

It is simply the stock sizes of long-radius WeldELLS in a single weight and material — merely a small fraction of the enormous line that includes more types of fittings, in more materials, more weights and more sizes than any other line.

Important though the breadth of the WeldELL line is to every man who designs or erects piping, still more important is the significant fact that the WeldELL family grew to this size because nothing less could meet the demand for fittings of WeldELL quality and uniformity to satisfy every conceivable piping condition.

Yes, there is a Taylor Forge Fitting for every purpose. From the smallest to the largest, every fitting in the WeldELL line shares the principle of sound engineering design and job-speeding utility that Taylor Forge has consistently applied for half a century.

Mail the coupon for Taylor Forge catalog.

TAYLOR FORGE

TAYLOR SPIRAL PIPE is available in a broad range of sizes and thicknesses. Coupon brings Spiral Pipe Bulletin 493.

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TAYLOR FORGE & PIPE WORKS
P. O. Box 485, Chicago 90, Illinois
Offices in all principal cities: *Eastern Plant:* Carnegie, Pa.
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☐ Please send Catalog 484 covering welding fittings and forged steel flanges.
☐ Send Bulletin 493 covering Taylor Spiral Pipe and related fittings.

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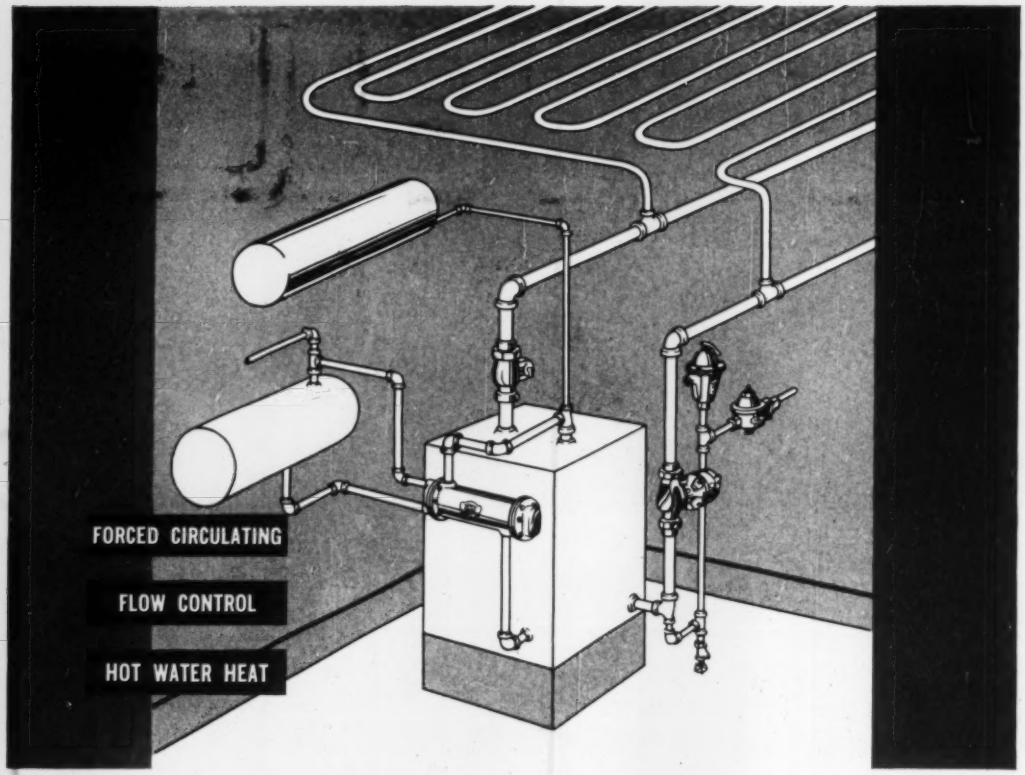

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Vertical or Angle Types,
With or Without Air Tube

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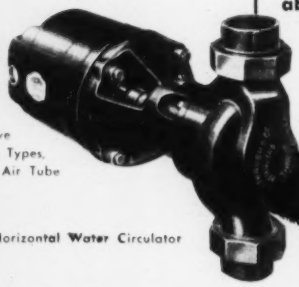

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GIVE YOUR customers the finest, most efficent Radiant Heat . . . Hot Water with Forced Circulating Thrush Flow Control System. It provides uniform heating without continuous Circulator operation. Maintains constant flow of radiant heat under all weather conditions. Summer-winter domestic hot water for kitchen, laundry and bath is provided automatically. Get our booklet giving the complete story of Thrush Radiant Hot Water Heat. Ask your wholesaler more about it or address Department E-12.

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H. A. THRUSH AND COMPANY

HOT WATER CONTROLS

PERU, INDIANA

The Importance of the Revolving Discharge Outlet in the Heating of Industrial Buildings

by D. Gilbert

The almost universal use of unit heaters for industrial plant heating indicates a conviction on the part of plant engineers, managers, consulting engineers and architects that this is the most satisfactory way of heating buildings and work rooms. Industry has come a long way, indeed, from the days not too long ago, when pipe coils, suspended from side walls or under windows, were the common means of heating a plant.

But, as pointed out in the article on Unit Heaters in a leading authoritative publication:

"In order to direct the air to points desired, and to diffuse the air to avoid drafts, unit heaters are commonly equipped with directional outlets, adjustable louvers, or fixed types of diffusers. . . . As hot blasts of air in the working zone are usually objectionable, heaters mounted on the floor should have their discharge outlets above the head line, and suspended heaters should be placed in such manner and turned in such direction that the heated air stream will not be objectionable in the working zone."

This is sound advice, but even with such stratagems, it is seldom possible to obtain satisfactory results. The basic difficulty lies in the use of *stationary* discharge outlets. Only one type of unit heater is able to avoid the objectionable "hot blasts" so distressing to workers in fixed positions, as on assembly lines or at machine tools. That is the heater suspended from roof or ceiling in which the downward discharge of heated air is distributed by slowly *revolving* discharge outlets. There are no fixed blasts, no chilly corners untouched by the air streams; just a gentle, thorough movement of the heated air at the working level, over obstacles, around obstructions, moving under tables, benches, truck bodies, airplane wings, even into repair pits. The result is an evenly warmed blanket of air at the working level, a gently moving, invigorating atmosphere that is pleasantly stimulating to the worker and better for his health.

Only Wing Revolving Heaters Circulate the Heated Air Around Obstructions

Industrial plant heating reaches its highest peak of perfection in the Wing Revolving Discharge Unit Heater. Unlike stationary discharge unit heaters, which project heated air in one or more fixed directions, the Wing Revolving Discharge outlets move slowly through a complete arc, flooding the entire heating area with a blanket of fresh, live warmth. The gentle air motion caused by the constantly changing directions of the heated air from the revolving discharge outlets eliminates the hot blasts and chilly areas common with stationary discharge type unit heaters—creates a refreshing, stimulating atmosphere beneficial to employee morale and productivity.

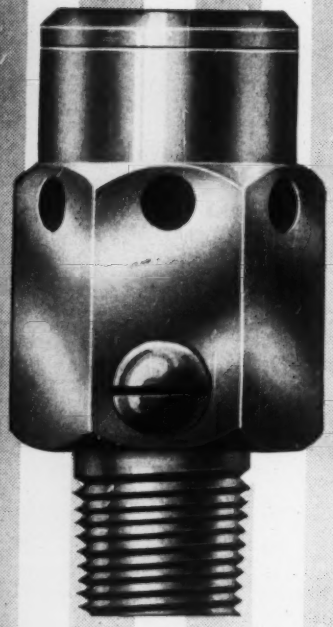
Successful applications of Wing Revolving Heaters have been made in every type of industrial plant, as well as other buildings with unique heating problems. Get complete information on this modern form of unit heating by writing today for a copy of Wing Bulletin HR-5.

L. J. Wing Mfg. Co.

Executive Offices and Factory: 140 Vreeland Mills Road, LINDEN, N. J.
Canadian Factory: Montreal, Canada

Manufacturing Licensee for Wing Unit Heaters in Western Europe—ETABLISSEMENTS WANSON—9, rue Mogador, Paris 9e, France Nouveau Boulevard de la Woluwe, Haren-Nord, Brussels, Belgium.

Wing
Revolving
UNIT HEATERS



New TACO-VENT

Automatic Hot Water Air Valve

VENTS THREE TIMES FASTER

If you've been enthusiastic about Taco-Vent, wait till you try these new models. They vent three times faster. In addition to quicker venting, the same quality features remain. Biltin porous bronze plug safely controls water flow to valve mechanism. No adjustment required. Install it and forget it.

BUY TACO-VENTS BY THE DOZEN AND GET THIS HANDY PLASTIC BOX FREE

Box can be re-used for small screws, bolts, nuts, fishing hooks, hair pins, powder, pins, jewelry, cuff links and other items you always have to keep safe and handy.

LOOK FOR THIS DISPLAY AT YOUR WHOLESALER

Better Heating-Better with Taco

Taco

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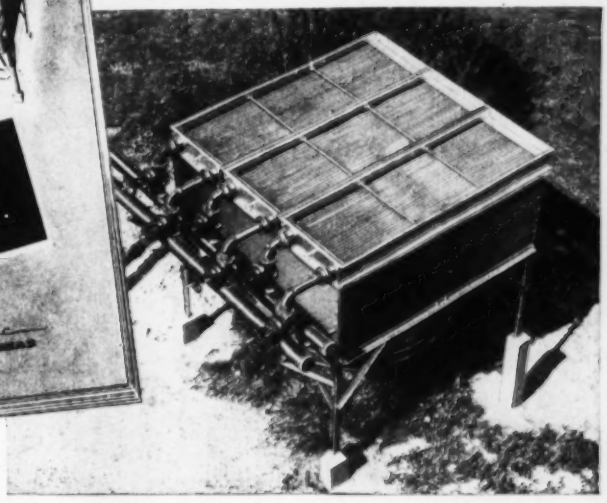
137 South St., Providence 3, R. I.

RATINGS & DATA ....YOU'LL WANT



on dry cooling equipment... DriCooler®

Whether you have an engine in a power plant — products to cool or condense in a natural gasoline plant — engines or gas to cool at a gas pipeline compressor station — high level heat dissipation in a refinery or a small standby engine to cool .... Marley has a DRICOOLER to do your job!

Small "packaged" DRICOOLERS or large industrial units are all built to give years of dependable service. All DRICOOLERS, large or small, have finned tubes that are easy to clean, quick to drain and have been tested for long life. Proven Marley mechanical equipment insures smooth, quiet operation.

DRICOOLERS are standard in forced or induced draft, horizontal or vertical coils, steel units or abestos-board covered redwood structures, and sections are available with various fin and tube materials and header arrangements.

WRITE FOR THE NEW DRICOOLER BULLETIN

- Gives rating tables for cooling water
- Lists dimensions and weights
- Shows coils, structure and mechanical equipment
- Photographs of actual installations

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Please send me without obligation Bulletin DC-50 on the complete line of Marley DRICOOLERS.

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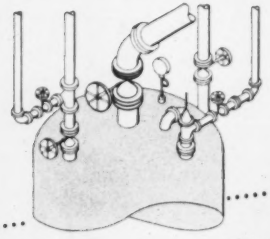
BASED ON FACTS REPORTED BY A CRANE VALVE USER

5 times-plus longer service

with dependable

CRANE VALVES



PROBLEM: To find a better replacement for valves that needed repairs every 2 to 3 weeks and failed completely in 3 to 4 months.

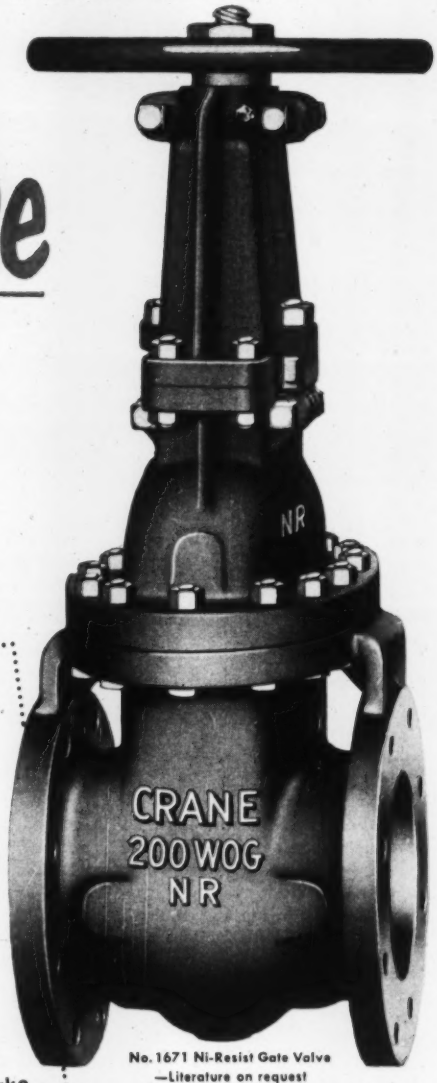
WORKING CONDITIONS: Valve exposed constantly to hydrochloric acid vapors at 50 psi, at approximately 280° F., while controlling raw material inlet line to starch converter.

SOLUTION: Crane No. 1671 Ni-Resist Cast Iron Gate Valve with Crane 18-8 Mo Alloy trim.

RESULT: On last inspection, after 19 months' service without one single interruption, Crane Ni-Resist valves were still in very good condition.

Here's an example of the long life and low-cost maintenance that make Crane Quality the best value in all types of valves.

More CRANE VALVES are used than any other make



No. 1671 Ni-Resist Gate Valve —Literature on request through your Crane Branch or Crane Wholesaler.

CRANE

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Ill.

Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

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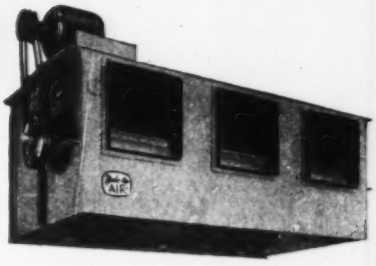

Make-Up AIR Unit

Corrects Air Starvation

Where gases, dust and fumes are removed in large volume with exhaust fans, depleting the air supply within the building, and creating a minus pressure, we recommend the installation of our Make-Up AIR Units.

These simple, compact, ceiling suspended units replace the air from the outside, in an even and constant flow, without drafts or noise; warmed, cleaned and delivered in definite known quantities to balance the known loss. Corrects drafty conditions and uncontrolled infiltration. Furnished in 4 sizes from 5,000 CFM to 20,000 CFM.

Bulletin 502 gives full details.

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All New York Blower Company products are laboratory tested, accurately rated and fully guaranteed in strict accordance with Standard Test Codes.

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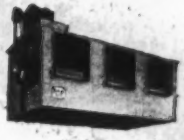

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JANUARY 22 to 26th, 1951

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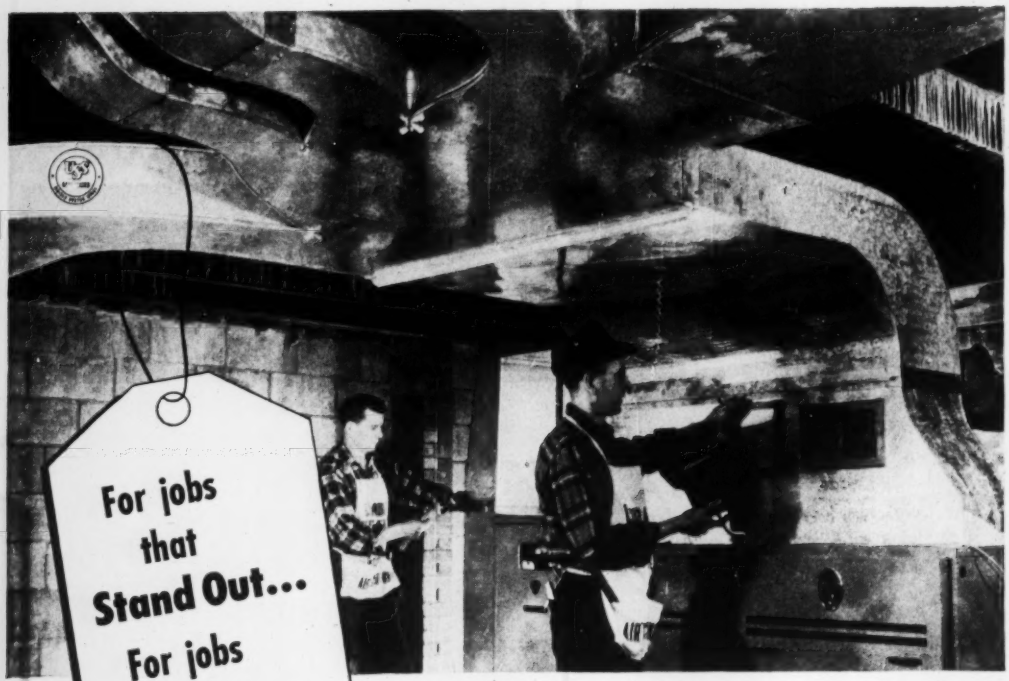

U·S·S Galvanized Sheets

THE better the material, the better the job! This familiar axiom certainly applies to sheet metal work.

Take the interior ductwork shown above, for example. Fabricated from U·S·S Galvanized Steel Sheets, it is about as neat and good-looking as any you're likely to see anywhere! Yet, you or any other skilled craftsman can easily turn out jobs just as smooth and satisfactory. But you can't obtain such results unless the sheets you use possess good forming characteristics.

That's why it will pay you to use U·S·S Galvanized Sheets. You can be sure of their quality. You can depend on their being uniform in surface, flatness and ductility. Their superior forming qualities will enable you to form difficult shapes and angles easily and accurately. You'll find that tight neat seams can be readily obtained with soldered, cemented or riveted joints. And, these superior sheets can be rolled, bent, cut and stamped with equally fine results.

When you need sheets, ask your supplier for those bearing the famous U·S·S trade-mark. You can't find better sheets at any price anywhere!

To stand up under severe atmospheric conditions

U·S·S GALVANIZED COPPER STEEL SHEETS

— give extra atmospheric corrosion resistance at little additional cost!

CARNEGIE-ILLINOIS STEEL CORPORATION, PITTSBURGH · COLUMBIA STEEL COMPANY, SAN FRANCISCO · TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM
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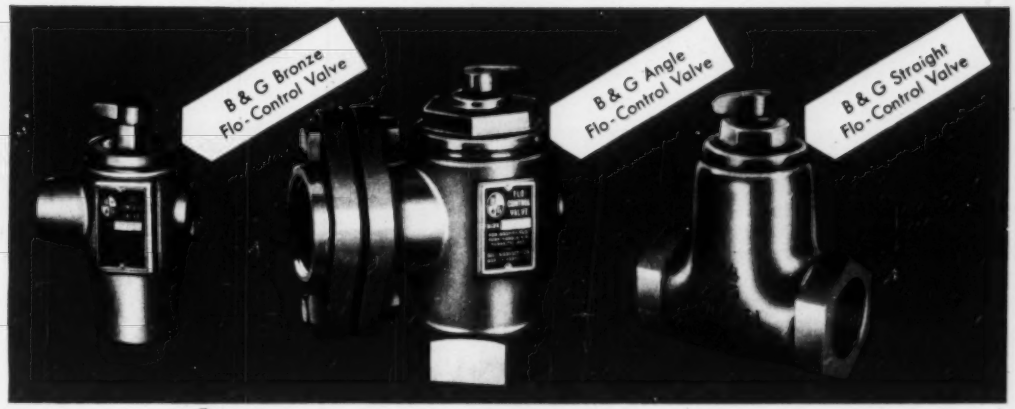
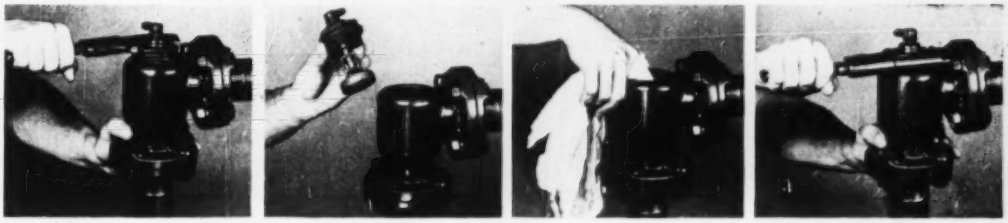
USS GALVANIZED STEEL SHEETS

0-1893

UNITED STATES STEEL



THE *Only* FLO-CONTROL VALVES WITH THIS EASY-CLEANING FEATURE

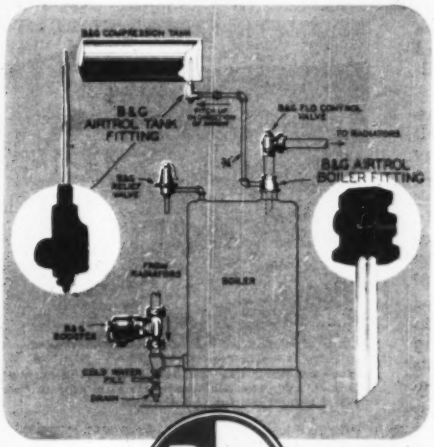


1 Unscrew the top cap

2 Lift out entire valve mechanism

3 Wipe off the seat

4 Replace the top cap



Cleaning the seat of a B & G Flo-Control Valve is a quick, easy job—*no pipe connections to break!*

The four simple steps illustrated above tell the story. *Unscrew the top cap—lift out the entire valve mechanism—wipe off the seat—replace the cap and the job's done!*

With B & G Flo-Control Valves you can also meet any piping problem the easy way—because you have a choice of either straight or angle patterns. Both kinds can be quickly adjusted for either automatic operation or gravity circulation. Size and capacity information is given in the B & G Catalog—write for your copy.

B & G AIRTROL SYSTEM

Removes air from a hot water heating system and keeps it out!

A really sensational cure for air trouble—proved successful in countless actual installations.

The B & G Airtrol System consists of two units—the Boiler Fitting and the Tank Fitting. Their combined function is to trap air in the compression tank and prevent its return to the boiler, piping and heat distributing units. The Airtrol System can be installed on any cast-iron or steel hot water boiler.

Hydro-Flo PRODUCTS

Forced Hot Water Heating Equipment . . . Heat Exchangers . . . Water Heaters . . . Centrifugal Pumps . . . Refrigeration Equipment

BELL & GOSSETT COMPANY

Dept. BV-5, Morton Grove, Illinois

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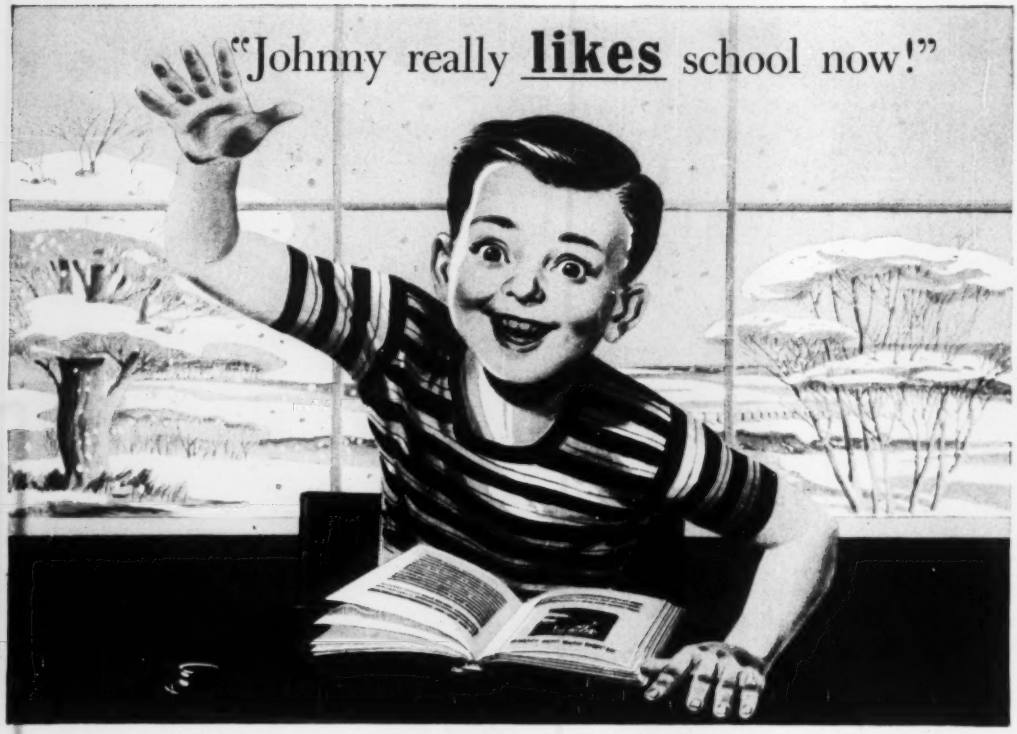


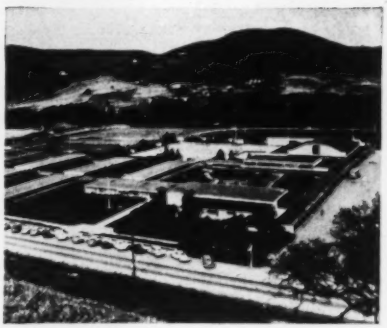
Steel pipe is first choice for radiant heated schools

It's a good thing Shakespeare didn't live in our day for he would have had to revise those familiar lines about the school boy . . . "creeping like snail, unwillingly to school!" Our millions of grand American kids really *like* school now!

And why shouldn't they? Americans believe firmly in the right of every youngster to get a good start in life! As a result our schools not only stimulate young minds but provide every comfort that science can devise and money can buy to make learning enjoyable, healthful and comfortable.

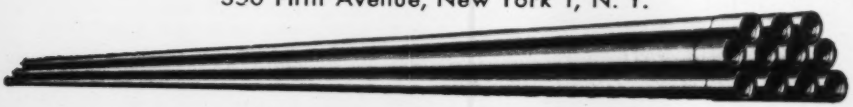
Good lighting, ventilation, and heating are "musts" in America's modern schools. In the newest ones even the advantages of *radiant* heating are included. And because "the best is none too good" steel pipe is first choice for these radiant installations.

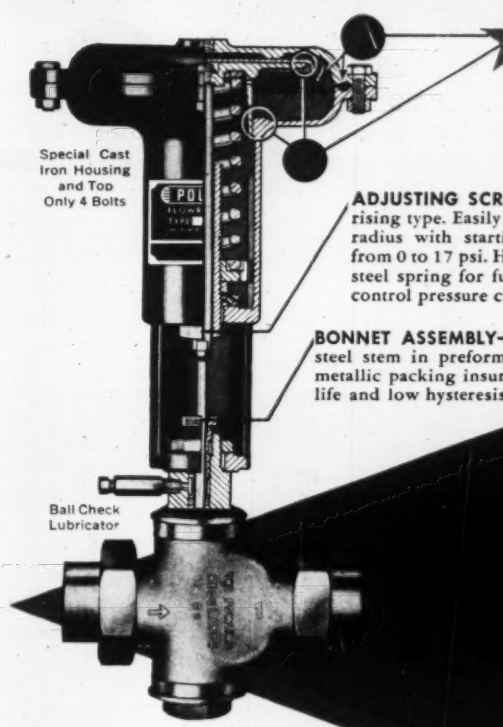
There are many reasons why! Steel pipe has been proved in more than 60 years' service in conventional hot water heating systems and, in addition, meets the *specific* piping requirements of radiant installations in *every* particular . . . from economical first cost to complete mechanical adaptability!



Modern schools like this new Acalanes Union High School, Lafayette, California, use steel pipe in floor panel radiant heating installations.

COMMITTEE ON STEEL PIPE RESEARCH
AMERICAN IRON AND STEEL INSTITUTE
350 Fifth Avenue, New York 1, N. Y.





VALVE TOP—Durable moulded neoprene diaphragm (A) has positive sealing bead which provides increased sealing action with increasing control pressure. Efficient diaphragm form insures ample and constant operating power thru full travel. Piston Plate Assembly (B) has a free floating thrust plate which absorbs side thrust. Closely guided piston plate maintains stem in accurate alignment.

See our exhibit at the 10th International Heating, Ventilating, and Air Conditioning Exposition, Philadelphia, Pa., Jan. 22-26, 1951.

ADJUSTING SCREW—Ball bearing non-rising type. Easily accessible, 180° turning radius with starting pressure adjustable from 0 to 17 psi. Has enclosed rust proofed steel spring for full travel in 5 or 10 psi. control pressure change.

BONNET ASSEMBLY—Polished stainless steel stem in preformed lubricated metallic packing insures long life and low hysteresis.

POWERS
LOWRITE
VALVE

✓ Check their many
OUTSTANDING FEATURES
that insure
BETTER PERFORMANCE

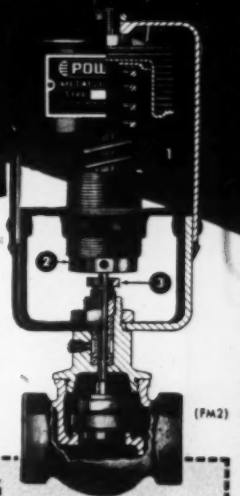
F and **M**

AIR OPERATED
CONTROL VALVES

• VARIETY of VALVE BODIES—Sizes ½" thru 8"

For line pressures up to 250 lbs. per square inch. Rugged construction to withstand piping strains. Single seat or double seat, bronze and stainless steel trim. Double unions and flanged ends. Available normally open (direct acting) or normally closed (reverse acting) and 3-way mixing type valves.

POWERS
ETAFLOW
VALVE



POWERS *Metaflow Valves* are small, sturdy, lightweight, reasonably priced, suitable for many control applications where the pressure differential does not exceed 75 lbs. per square inch.

SPECIFICATIONS

1. **HOUSING**—High strength aluminum alloy. Hydraulically formed long life brass bellows provides smooth and powerful stroke.

2. **ADJUSTING SCREW**—Brass with rust proofed steel spring having 15 lbs. adjustment range to give proper sequence operation where required

3. **BONNET ASSEMBLY**—Polished stainless steel stem in preformed lubricated metallic packing insures long life and low hysteresis.

VALVES—Sizes: ½" thru 2", bronze bodies with screwed ends, maximum body pressure 125 lbs., rugged construction to withstand piping strains. Stem lubricator, optional.

TRIM—Composition disc with brass integral seat and self-aligning disc holder. Available normally open (direct acting) or normally closed (reverse acting), and 3-way.

(FM2)

METAFLOW PACKLESS VALVES prevent leakage of inflammable or harmful liquids or gases and provide vacuum protection. Are suitable for use with Freon, oil, gasoline, non-corrosive gases, hot or cold water and low pressure steam.

THE POWERS REGULATOR CO.
2700 Greenview, Chicago 14, Ill
Send further information and prices on POWERS
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☐ Control Instrument for _____
(Process or Operation)
Name _____ Title _____
Address _____
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ALL YOUR
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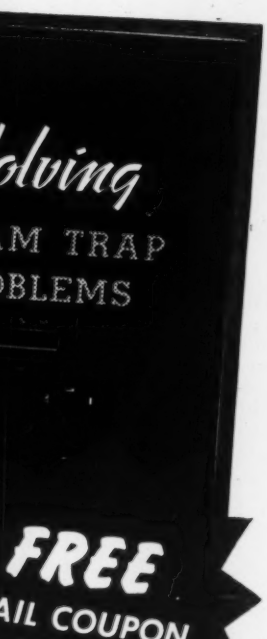
about correct steam trapping

Here's a book that is especially prepared to answer all your questions about correct trapping of steam lines. Filled with helpful reference data, "Solving Steam Trap Problems" saves your time and money by giving you easy-to-follow formulas for proper trap selection. This book also contains many helpful hints on how to keep equipment at top efficiency by removing all condensate and air, as well as how to install and service traps. This valuable book is yours without cost. Simply attach coupon to your business letterhead and mail.



FREE
MAIL COUPON BELOW

HOW CAN I SELECT THE RIGHT TRAP FOR ANY INSTALLATION?

This 36-page book makes it easy to specify the correct steam trap. You'll save time and money by being able to determine the right trap for any installation in just a matter of minutes.

HOW MANY FITTINGS CAN I SAVE PER INSTALLATION?

It is no longer necessary to use three elbows and four nipples for the average steam trap installation. "Solving Steam Trap Problems" shows how to install a trap with a single fitting, saving 60 minutes of installation time.

WHY IS IT IMPORTANT TO TRAP UNIT HEATERS?

Learn how to get maximum heat from unit heaters! The heat delivery of a unit heater depends, among other things, on how completely the steam compartment is filled with dry hot steam. The correct method of trapping unit heaters to obtain maximum efficiency is fully explained.

WHAT IS FLASH STEAM?

Flash steam is frequently mistaken for live steam and a steam trap condemned when it is still satisfactory. You'll find a complete explanation of flash steam and how to distinguish from live steam.

ALSO HOW CAN I DETERMINE THE RIGHT TRAP FOR

• Pipe Coils and Heating Surfaces in Still Air • Fan System Heating Surfaces • Steam Jacketed Kettles • Autoclaves • Submerged Surfaces • Hospital Equipment • Kitchen Equipment • Laundry and Dry Cleaning Equipment • and many others.

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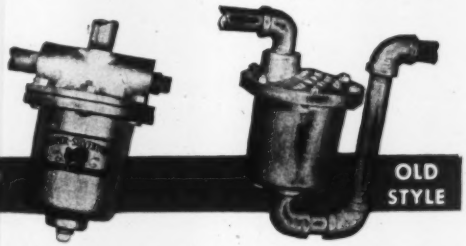

USE SUPER-SILVERTOP IN-LINE OR AS AN ELBOW

Save Money With SUPER-SILVERTOPS

THE V. D. ANDERSON COMPANY
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Gentlemen: Please send without obligation your book "Solving Steam Trap Problems."

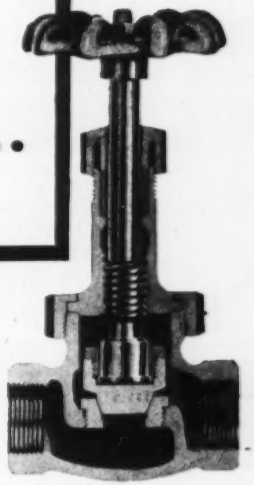
Name .....

Address .....

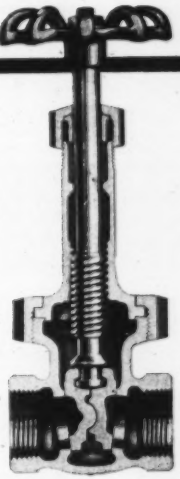
City ..... *State* .....

In Canada: Bawden Machine Co., Toronto

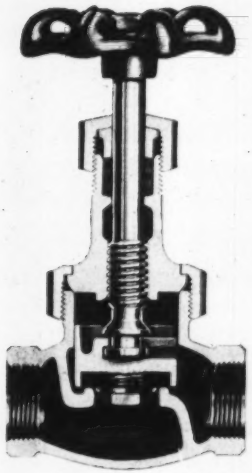
Walworth bronze valves...



Walworth No. 225P Globe Valve
500 Brinell Seat and Disc



Walworth
No. 29 Gate Valve



Walworth No. 95 Globe Valve
Re-New-Disc

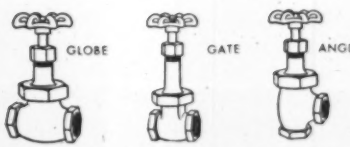
built to give dependable trouble-free service on all recommended jobs

Walworth No. 95 Bronze Globe Valves (Angle Type: No. 96) are recommended for service where throttling is not required. They are rated at 150 psi working steam pressure, 500F; 300 psi cold water, oil or gas. The improved renewable disc and lock-on, slip-off disc holder — an original Walworth development—saves time and trouble. This valve can be repacked under pressure when fully opened. All parts are designed to give maximum service and strength.

Walworth No. 29 Bronze Gate Valves are rated at 200 psi working steam pressure, 550F; 400 psi cold water, oil and gas. These valves have rising stems and integral seats. Sizes 2-inch and smaller have union bonnets; sizes 2½ and 3-inch have bolted bonnets. Valves up to and including ¾-inch have solid wedge discs; 1-inch and larger have split wedge discs. These valves can be repacked under pressure when fully opened.

Walworth No. 225P Bronze Globe Valves (Angle Type: No. 227P) are rated at 350 psi working steam pressure, 550F; and 1000 psi non-shock service on cold water, oil and gas. The stainless steel, plug type seat and disc — heat treated to 500 Brinell — can be closed on sand, slag, scale and similar floatage, without injury to the seating surfaces. They are the longest wearing, TOUGHEST bronze valves you can buy.

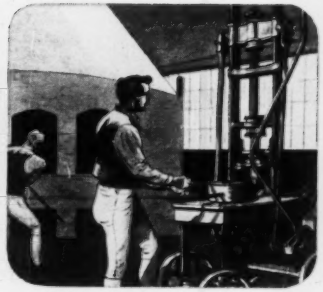
For full information about Walworth Quality Bronze Valves, see your Walworth distributor, or write:



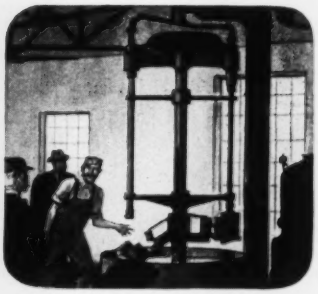
WALWORTH
valves and fittings
60 EAST 42nd STREET NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

1 **1621**—Glass was money! America's first glass factory was actually a mint—not for the manufacture of coins but to make glass beads for *use* as money when buying land, food and furs from the Indians.



2 **1827**—Blown glass was the rule until Enoch Robinson, a carpenter, figured glass could be *pressed* into shape . . . the glass pressing machine was born. Electricity to power new machines was still to come.



3 **1899**—Owens invented a machine to make bottles as the machine age arrived in glass. By 1915, Howell "Red Band" Motors were making important contributions to this and other industries.

ANOTHER HOWELL SUCCESS STORY

GLASS... from artisans to automatic machines

4 **Today**—Modern, electrically driven machines have improved quality, cut costs and increased output in the glass making industry. For example, this unique glass beveling machine, equipped with 7 dynamically balanced Howell Motors, *automatically* bevels glass at the rate of 2,000 inches per hour!

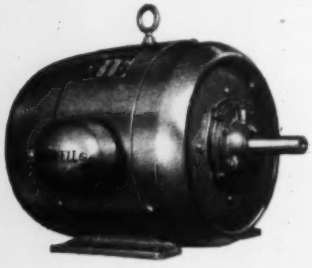
You'll also find precision-built Howell Industrial Type Motors powering bottle and bulb machines, conveyors, grinders, polishers, plate and window machines in the glass industry.

Elsewhere, Howell's wide range of standard NEMA motors, and special motors designed to customer requirements, serve dependably and efficiently under the toughest conditions.

For a really profitable investment, buy HOWELL!

Free enterprise encourages mass production, supplies more jobs—provides more goods for more people at less cost.

Howell totally enclosed, fan-cooled motor—windings completely sealed against dirt and weather.



HOWELL MOTORS

HOWELL ELECTRIC MOTORS CO., HOWELL, MICH.

Precision-built Industrial Motors Since 1915

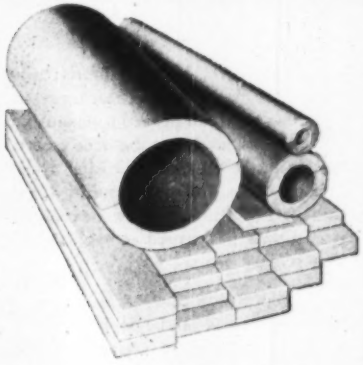
HOWELL Red Band MOTORS

KAYLO HEAT INSULATION
PASSES THESE SEVERE TESTS

BOILING TEST: Samples of Kaylo Heat Insulation have been boiled continuously for 24 hours and longer. None disintegrated or showed any loss of insulating efficiency after drying.

FUME TEST: Samples of Kaylo Heat Insulation were suspended in an aerated mixture of water vapor and SO_2. The Kaylo samples showed no deterioration after weeks of direct exposure.

One Material Insulates Efficiently up to 1200°F.



Kaylo Heat Insulation is made of hydrous calcium silicate (not glass), a remarkable material with high insulating efficiency up to 1200°F. This new type of inorganic insulating material retains its stability in long service under severe conditions. Exceptional strength and lighter weight make it easier to handle and apply.

KAYLO PIPE INSULATION is produced in Simplified Dimensional Standards of thicknesses and diameters for pipe sizes from ½" to 72". Coverings are sectional for sizes ½" to 12"; tri-segmental for 8" to 23"; quad-segmental for 19" to 41"; K-segmental (18" sections) for 38" to 72". O.D.'s of insulation correspond to O.D.'s of standard pipes.

KAYLO HEAT INSULATING BLOCK is available for single layer application in thicknesses from 1" to 6". It is made in all standard sizes up to 18" x 36".

KAYLO®

PIPE INSULATION AND HEAT INSULATING BLOCK

OWENS-ILLINOIS GLASS COMPANY
Kaylo Division • Toledo 1, Ohio

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Gentlemen: Please send me descriptive literature on Kaylo Heat Insulation.

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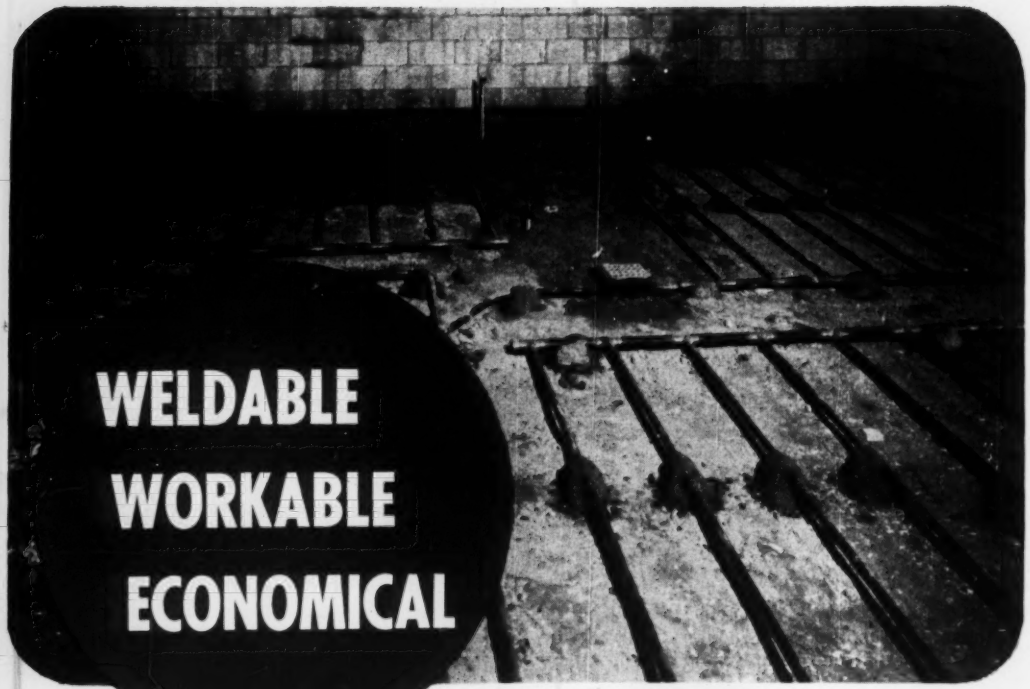
CITY.....STATE.....



—for Radiant Heating Panels

WELDABLE: Republic Steel Pipe wins warm welcomes on radiant heating jobs. Where feeder lines and grids must be joined, this advanced steel pipe welds readily to tight, leak-proof joints by all modern methods. And, it comes to you in long lengths that speed installations by reducing the number of joints.

WORKABLE: Manufactured under Republic's *improved* Continuous Weld Process it is uniform in wall thickness, diameter and concentricity . . . highly ductile . . . suitable for close coiling and bending. With an expansion co-efficient equal to that of concrete and plaster, it is perfectly adaptable to ceiling and sidewall panels as well as floor panels.

ECONOMICAL: Nothing more costly is needed for closed radiant heating systems. That fact has been proved time and again by the remarkably trouble-free record of steel pipe in all closed heating systems. What's more, *today's* Republic Continuous Weld Pipe is even better than that which has served so well over the past twenty years.

Your Republic Pipe Distributor will be glad to give you the latest word on available sizes and current delivery schedules. Check with him soon.

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GENERAL OFFICES • CLEVELAND 1, OHIO
Export Dept.: Chrysler Building, New York 17, N.Y.

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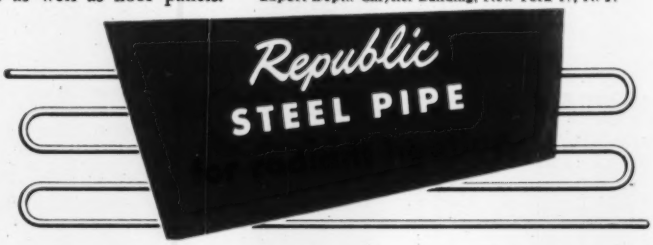
Uniformly Strong
Uniformly Ductile
Uniformly Clean and Scale Free
Easy to Weld by All Modern Methods
Easy to Bend, Thread and Close Coil
Economical Uniform Lengths, Extra Long Lengths
Uniform Wall Thickness, Diameter, Concentricity
Expansion Co-efficient Same as Concrete and Plaster



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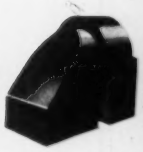
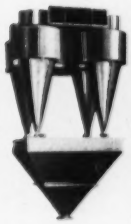
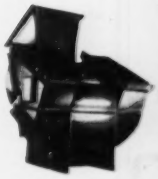


Utility Sets

Ventura
Ventilating Fans



Dust Collectors



Mechanical
Draft Fans

Industrial Fans

Heating and
Cooling Coils

Air Conditioning
Equipment

In Pittsburgh, as in other cities, American Blower Air Handling Products serve commerce, industry and public utilities. For air handling data in the Pittsburgh area, call American Blower—Atlantic 1-3496. In other areas, consult your phone book.

All air handling equipment is not alike. There's a vast difference in quality, design, quietness, operating costs and efficiency. Look before you buy—and you'll buy American Blower products, the accepted standard and proved in test after test by buyers.

Air is free . . . use it profitably!

The owner of a bakery in Boston . . .

The operator of a great public utility in Philadelphia . . .

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All these buyers enjoy one thing in common when they buy American Blower equipment.

They get equipment which is built by a reputable manufacturer with a background of more than 69 years' experience—equipment which is tested in accordance with the Standard Test Code and carries Certified Ratings. In addition, they know that, whether the product costs $43.75 (price of a small ventilating fan) or runs into thousands (power plant equipment), they get the benefits of American Blower's broad scale engineering and research experience.

These are *real plus values* which insure satisfied customers and build repeat business.

They are additional reasons why the better contractors everywhere prefer to sell and install American Blower products.

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AIR HANDLING EQUIPMENT

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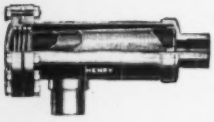
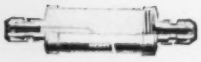
HENRY *really gives you something extra*

a few of many outstanding advantages





IN PACKLESS VALVES, still the only Balanced-Action valve on the market—no extra cost

IN STRAINERS, forged brass end caps with integral fittings, reinforced screen, large filtering area, distortion-proof clean-out flange

IN DRIERS, forged brass end caps with integral fittings, natural finish, Abso-Dry pressure sealed, dispersion tube and extra capacity

IN WING CAP VALVES, greater flow, bolted bonnet and self-aligning stem disc

IN RELIEF VALVES, diaphragm construction, positive controlled cushion reseating with relief capacity that meets latest code requirements

IN AMMONIA VALVES, compact and strong, self-aligning stem disc

IN ALL HENRY PRODUCTS—ADVANCED FIELD-PROVEN DESIGN AND CONSTRUCTION

Sold by Leading Wholesalers

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HENRY VALVE CO. CONTROLLING FLOW

Valves · Driers · Strainers · Control Devices and Accessories for Refrigeration, Air Conditioning and Industrial Applications

MELROSE PARK, ILL. (CHICAGO SUBURB)
CABLE: HEVALCO, MELROSE PARK, ILLINOIS

BRUNNER SINCE 1906 REFRIGERATION helps you serve better

Your Good Name and Ours

could form a profitable partnership

Talk to anyone in the trade who has specified and installed Brunner Refrigeration Condensing Units and they'll tell you *from experience* what it means in business dollars and cents to deal with a progressive, understanding organization that builds its products just a little bit better than is expected.

You, as a contractor, need not be told how much easier it is to "sell" a job when you are in a position to specify and deliver *known* and *accepted* equipment.

The Brunner Manufacturing Company, with all their 44 years continual growth, has moved ahead so fast these past few years there are still some aggressive contractors who have missed the important details of what we may be able to contribute to their efforts toward securing more *profitable* business.

If you are at all concerned in the specifying and installation of refrigeration and air conditioning equipment, Brunner has a story to tell that you should at least know about. A factory representative will call without obligation. Write us and say when.

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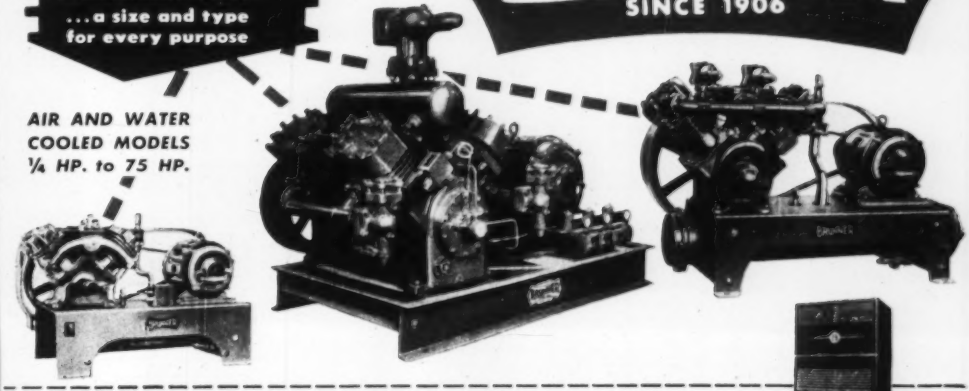
...a size and type for every purpose

BRUNNER SINCE 1906

AIR AND WATER COOLED MODELS
¼ HP. to 75 HP.



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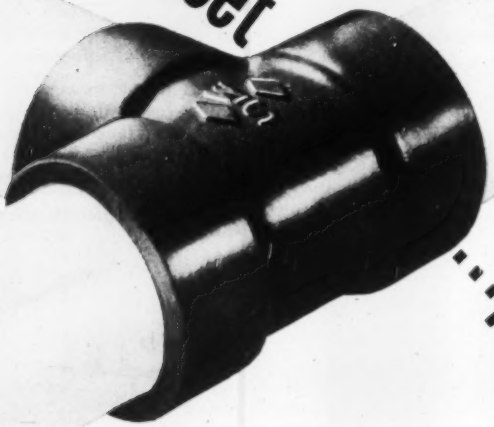
Self Contained Units in 4 sizes: 3 - 5 - 7½ and 10 HP.
Remote Installation Types from 5 to 75 HP.

Wherever pipes meet ...permanently



IN THE REFRIGERATION FIELD,

the surest and safest way to prevent fittings leaks is to install W-S Double-diamond Screw End and Socket Weld Forged Steel Fittings.

Designs are carefully engineered. Basic Materials are selected from a wide choice of carbon, stainless and alloy steels. Drop forging and precision machining makes them light in weight, assures accuracy of finish, and, all are instrument inspected for perfection of threads, sockets, angles and concentricity. Investigate them today.

Write for Bulletin A3-50. For information on stainless and alloy steel fittings ask for Bulletin S-1.

SOLD THROUGH LEADING DISTRIBUTORS EVERYWHERE

SPECIFY...

W-S

FORGED STEEL FITTINGS

DISTRIBUTORS PRODUCTS DIVISION **WATSON-STILLMAN** ESTABLISHED 1848 • ROSELLE, NEW JERSEY

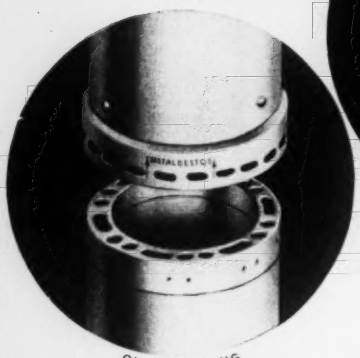
Designers and Manufacturers of Forged Steel Fittings, Valves, Wire Rope Shears, Hand Pumps, Jacks, Pipe Benders and Hydraulic Equipment

WHEREVER automatic controls are required—on any project, large or small—your greatest assurance of accuracy and dependability lies in Honeywell. For only Honeywell offers a complete line of controls—pneumatic, electric and electronic. Too, Honeywell has an outstanding reputation, backed by more than a half century of leadership in the manufacture of heating, ventilating and air conditioning controls for every purpose. Place your confidence in products that are internationally known and accepted—Standardize on Honeywell!

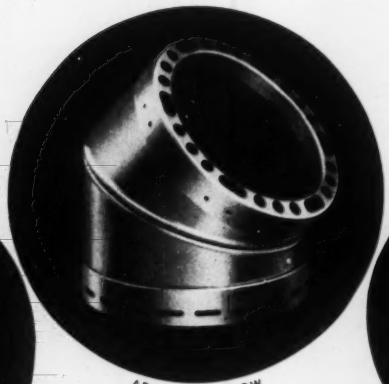
Consult Honeywell's Engineering Staff . . . 77 Branches to serve you in principal cities from Coast-to-Coast.

MINNEAPOLIS
Honeywell
FIRST IN CONTROLS

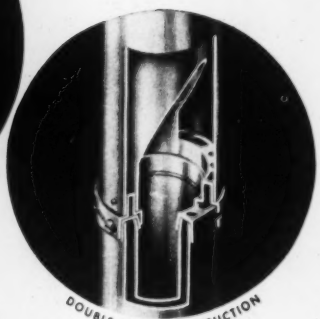
77 BRANCHES FROM COAST TO COAST WITH SUBSIDIARY COMPANIES IN: TORONTO • LONDON • STOCKHOLM • AMSTERDAM • BRUSSELS • ZURICH • MEXICO CITY



QUICK COUPLING



ADJUSTABLE ELBOW

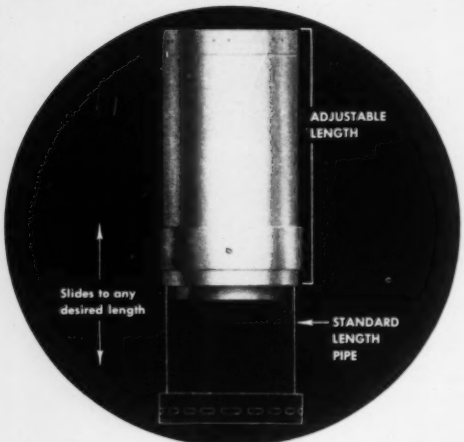


DOUBLE WALL CONSTRUCTION

FASTER–SAFER VENTING

WITH U.L. LISTED

QC METALBESTOS



ADJUSTABLE LENGTH

RAPID ASSEMBLY:

Metalbestos die-formed couplers are so quickly connected without using special tools or skills that installation time is held at a minimum. A few versatile Quick-Coupling fittings fulfill many needs common to all gas vent installations which previously required special handling.

LOWER LABOR COSTS:

Adjustable lengths and combination fittings eliminate cutting, crimping, waste and costly fabrication. Three sheet metal screws automatically align each gas-tight joint without the use of mastic, cement or banding material.

EFFICIENT, SAFE VENTING:

Metalbestos is designed solely for the specialized problems of venting gas appliances. The famous pipe-within-a-pipe construction provides complete protection against gas fumes and fire hazards while assuring a quick, strong draft for proper venting.

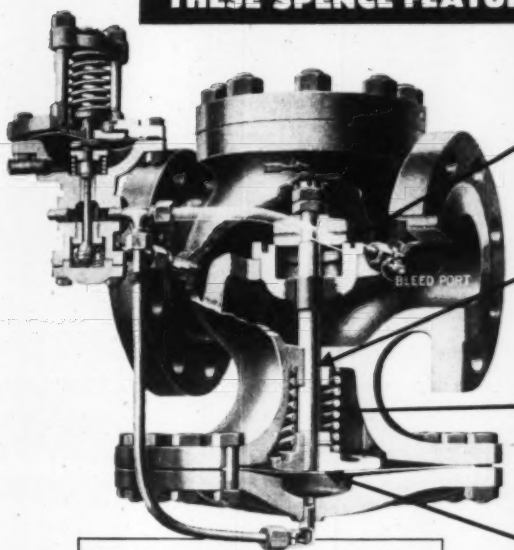
Order from your jobber today or write to Dept. N

METALBESTOS DIVISION
WILLIAM WALLACE COMPANY • BELMONT, CALIF.

HERE'S PROOF

You Can Cut Costs of Pressure and Temperature Control

THESE SPENCE FEATURES SHOW YOU HOW



SPENCE Type ED Pressure Regulator

SECO METAL SEATS AND DISCS — Durable SECO Metal resists wiredrawing. *More than twenty years of experience* in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

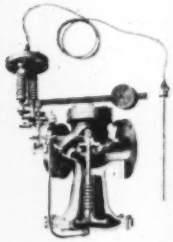
PACKLESS CONSTRUCTION — All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . eliminates much time-consuming maintenance.

SPRING OUT OF PATH OF STEAM — The spring in the Spence Regulator is out of the path of the steam or other fluid flowing through the valve. It operates at low unit stress for exceptionally long life.

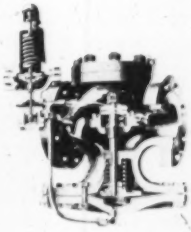
LARGE BALANCED DIAPHRAGM—Spence metal diaphragms, under usual conditions, never require replacement. Spence Regulators have few moving parts and those few are ruggedly constructed and seldom require attention.

YOU BENEFIT by these and many other Spence features that assure *accurate, dependable* regulation year after year. That means *less down-time, less time and money wasted on replacement of parts.*

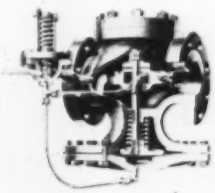
Spence Pressure and Temperature Regulators are built in sizes from *¼" to 12"* for service with *air, steam, water, oil or gas.* Only minor adjustments are needed to switch any Spence Regulator from one service to another.



Type ET150 Temperature Regulator—Taps in performance for both storage and instantaneous heaters.



Type EN Differential Regulator—Accurately controls differential between fluid delivered by regulator and some other source of pressure connected to the pilot spring chamber.



Type EQ Back Pressure Regulator — Completely packless, pilot operated for accurate control of the initial pressure.

These Companies Have Profited with SPENCE!

The Springs Cotton Mills
Ford Motor Company
Pennsylvania Power & Light Company
Jones & Laughlin Steel Corporation
National Tube Company
The Atlantic Refining Company
Great Lakes Steel Corporation
Todd Shipyards Corporation
Land O'Lakes Creameries, Inc.
General Electric Company
R. J. Reynolds Tobacco Company
Ohio Edison Company

and thousands of others

SPENCE ENGINEERING COMPANY INC.
WALDEN, NEW YORK

Spence

How do you want your WOLVERINE TRUFIN*?

Both are made by the same Wolverine patented process and have fins integral with the tube—which means that the fins cannot come off or even become loosened by vibration or temperature changes. The fins are part of the tube itself; they are extruded from the solid tube.

Both kinds of Trufin are available in all popular sizes and fin spacings. Each type has its own specific purpose. Its use depends on the characteristic of the fluid or gas you pass through it on the inside or over it on the outside.

In the case of the new bi-metal Trufin, for instance, you have the advantage of a corrosion resistant liner (copper or other alloy) with the light weight of aluminum fins—giving you a combination of extremely high efficiency in performance and a substantial saving in cost.

Our Engineering Department can help you with the choice of finned tube that will assure the best results in operating heat exchangers or other similar units.

We have booklets that give much valuable information regarding what to expect from certain installations and from finned tubes made of one metal alone or two in combination. If you want copies, please request them on your stationery.

*REG. U.S. PAT. OFF.

Wolverine Trufin and Wolverine Spun End Process available in Canada through the Unifin Tube Co., London, Ontario.

WOLVERINE TUBE DIVISION
Calumet & Hecla Consolidated Copper Company
INCORPORATED
MANUFACTURERS OF SEAMLESS NON-FERROUS TUBING
1419 CENTRAL AVE. • DETROIT 9, MICHIGAN

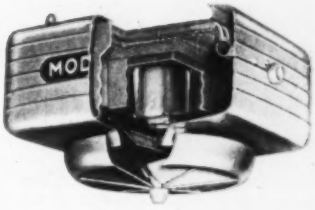
Plants at Detroit, Mich. and Decatur, Ala.

Stocks Available at All Wolverine Mill Depots:
DETROIT, MICH. • DECATUR, ALA. • HOUSTON, TEXAS
LOS ANGELES, CALIF. • LONG ISLAND CITY, N. Y.

Sales Offices in Principal Cities

It pays to check the field when selecting Unit Heaters

BET ON CONSTRUCTION

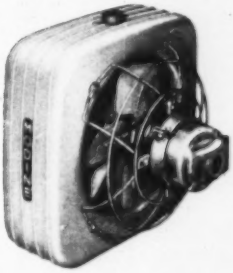


Long service life—that's what you get when you select Modine Unit Heaters. Steam-carrying passages are made only of corrosion-resistant copper and copper alloy. For greater pressure-resisting strength tubes and headers are cylindrical, brazed at the joints. Individual expansion bends absorb differential stresses. Parker-Bonderizing protects steel casings against rust.

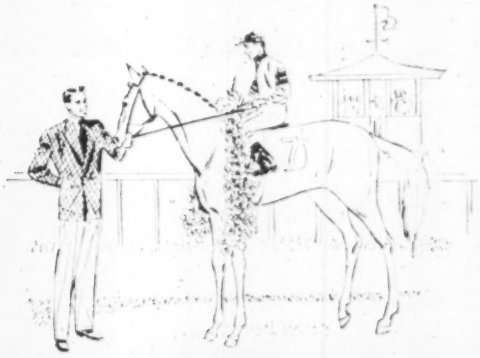
BET ON PERFORMANCE

Whatever model you may choose — *Horizontal, Vertical,* or *Power Throw* — Modines give you unmatched performance. It's performance based on skillful engineering—performance that offers you the right combination of correct outlet temperature and sufficient air velocity for floor-to-ceiling comfort . . . maximum economy.

BET ON STYLING



Front view, rear view — anyway you look at it, Modines are styled *right*, styled for truly functional beauty *on the job*. Their sleek, simple lines incorporate built-in safety fan guards. Resilient rubber mountings absorb motor noises. Scientifically designed venturi fan shrouds eliminate noisy eddy currents.



You get the winner every time when you select Modine

Yes, after *checking the field*, you'll just naturally select Modine Unit Heaters. On the job in factories, stores, hundreds of other locations, Modine Unit Heaters stand out in efficient, low-cost service. Get all the facts from your nearest Modine Representative. He's listed in the classified section of your phone book. Or write direct. Modine Mfg. Company, 1509 Dekoven Avenue, Racine, Wisconsin.

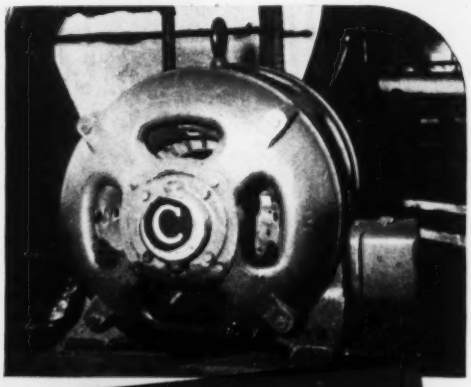
Ask for Modine Unit Heater Bulletin 149A. Also available — bulletins covering special applications in commercial brooder houses, greenhouses, and milk houses.

U-1078

Modine UNIT HEATERS

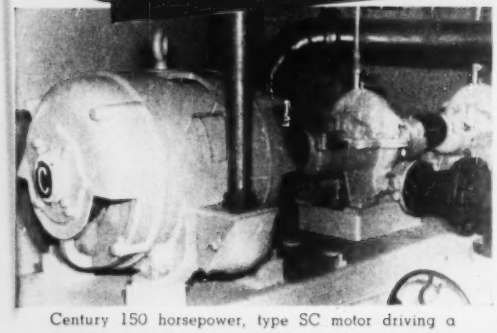
FOR FACTORIES • STORES • GREENHOUSES • COMMERCIAL BROODER HOUSES • MANY OTHER APPLICATIONS

Century 40 horsepower, type SC motor driving an induced draft fan for a stack.

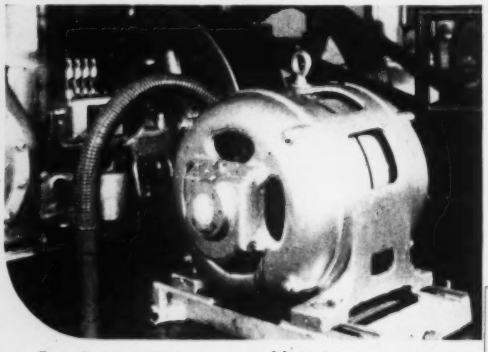


From Century's Line of Electric Motors You Can Select

1. **Right Kind**—*to match your current supply*
2. **Right Type**—*to meet your load characteristics*
3. **Right Protection**—*against atmospheric hazards*
4. **Right Size**—*from 1/6 to 400 horsepower*



Century 150 horsepower, type SC motor driving a two-stage centrifugal pump in a city water plant.



Two Century 75 horsepower SC high torque motors driving refrigeration compressors.

The wide range of kinds, types and sizes of Century motors makes it possible to select a standard motor to meet the requirements of all popular applications.

They are available for both AC and DC current—high, normal and low torque characteristics. Types are also available for applications requiring varying speeds and reversing direction of rotation.

To protect against atmospheric hazards, Century motors are enclosed in open rated drip proof, splashproof, totally enclosed fan cooled and explosion proof frames. Many types are available with vertical and flange mountings as well as standard horizontal bases.

Specify Century motors for all your electric power requirements.

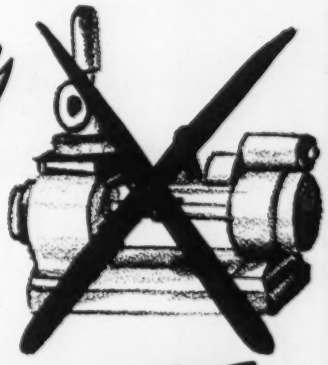
Popular sizes and standard ratings are generally available from factory and branch office stocks.

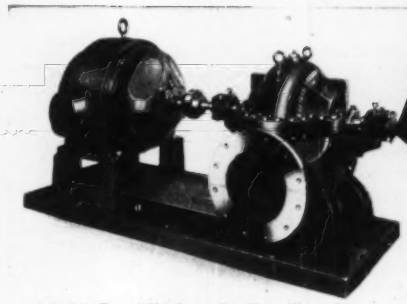
Century C MOTORS

CENTURY ELECTRIC CO.
1806 Pine Street, Saint Louis 3, Missouri
Offices and Stock Points in Principal Cities

-624

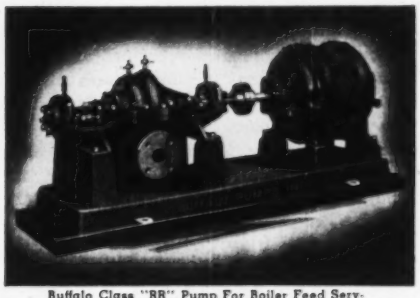
Yesterday's Pumps Doing Today's Job?





REPLACE with "Buffalo" PUMPS

Buffalo Type "SL" Pump For Clear Water Service. 10 to 10,000 gpm Capacities. Write for Bulletin 955-N.



Buffalo Class "RR" Pump For Boiler Feed Service. Write for Bulletin 980-B.

- **YOU'LL SAVE IN MAINTENANCE**
- **YOU'LL SAVE IN POWER CONSUMPTION**
- **YOU'LL REDUCE PROCESS TIMEOUTS**

Yes — if you are doing a present-day capacity job in your plant, but doing it on pumps that have long been obsolete — it's a money-saving proposition to replace with modern "Buffalo" Pumps!

You'll find that, where those old pumps were continually on the "repair list", and were hogging power, your "Buffalo" Pumps will use little power for the work done — and require practically no attention over many years.

And there's a "Buffalo" Pump for best work on every special job — clear water or chemical. WRITE US YOUR PROBLEM — for the best replacement you can make.

BUFFALO PUMPS INC.

171 MORTIMER ST. BUFFALO, NEW YORK

Canada Pumps, Ltd., Kitchener, Ont.

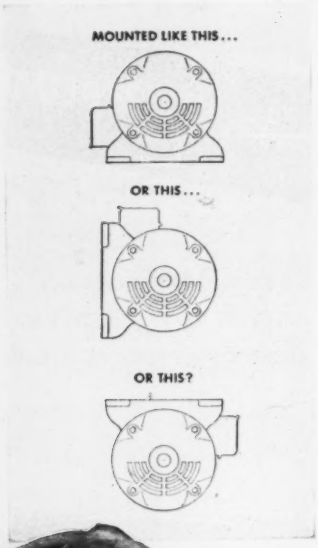
Branch Offices in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

YOU CAN BE **SURE**.. IF IT'S
Westinghouse

FOR AIR HANDLING

Is your motor *really* dripproof?



. . . AT ANY ANGLE OF MOUNTING— Do you see a ventilating opening in the frame? Then the motor is probably not dripproof when side wall or ceiling mounted. You need a special motor for these mounting positions . . . with special protection over frame openings. But . . .

You can save the costs of specials with Life-Line motors. Solid frame construction eliminates frame openings. All ventilation is accomplished through the end brackets. Simply rotate the 4-position brackets and the Life-Line is dripproof—for side wall or ceiling mounting.

Dripproof conduit box can be rotated also. Plenty of knockouts give maximum possible connections. And, because a Life-Line motor needs no further lubrication, you can crowd it into cramped quarters . . . mount it in "hard-to-get-at" locations—and forget it. Thus, you get maximum mounting flexibility for difficult mounting problems.

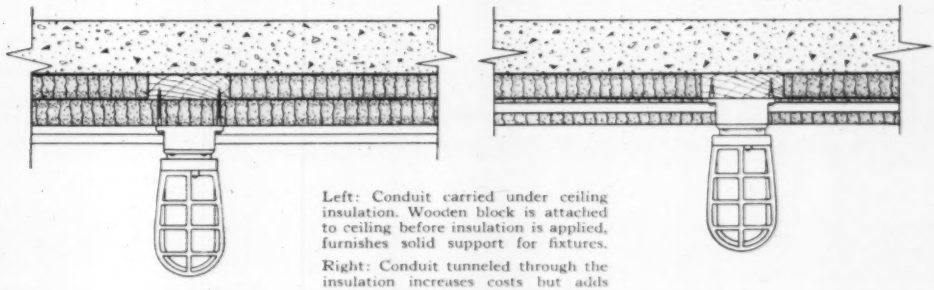
It costs no more to get these "special" features in a standard motor. Simply specify Life-Line as the drive for your equipment. Ask your local Westinghouse representative for details and a copy of booklet B-3842, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21583

If you figure LIFE-COSTS . . . you'll figure LIFE-LINE

Westinghouse

Motors

INDUSTRY'S LEADING MOTOR



Left: Conduit carried under ceiling insulation. Wooden block is attached to ceiling before insulation is applied, furnishes solid support for fixtures.

Right: Conduit tunneled through the insulation increases costs but adds to neat finished appearance of room.

We have been asked . . .

"HOW DO I HANG ELECTRICAL FIXTURES FROM A CORK CEILING?"

"I am planning to build a large freezer room, to be insulated with 6" of corkboard," writes a man about to enter the frozen food distribution business. "I have heard that dropping outlets through the ceiling reduces the efficiency of the insulation. Is this true, and if it is, how do I hang electrical fixtures from a cork ceiling?"

HERE'S THE ANSWER:

Dropping electrical outlets through a freezer room ceiling violates a cardinal principle of cold room construction: that is, the insulation envelope should be broken only at a minimum number of places. Metal conduits are good conductors of heat and warm air. Moisture in the air flowing into the room through the break made by the conduit will condense, turning to ice in the surrounding insulation, and on the outer surfaces of electrical fixtures. The same thing happens inside the conduit. Over the years, this condensation and freezing is bound to have a damaging effect on both the insulation and the electrical wiring.

Freezing in and around conduits and fixtures can be avoided by bringing all electrical wiring in through one conduit, sealed into the wall. Warm air can be kept from flowing through the conduit with a special sealing condulet outside the wall. In the room, leads are distributed under the ceiling. The problem of holding the fixtures to the cork ceiling is solved by the use of wooden blocks, fastened to the ceiling in the first layer of insulation. Blocks should be at least 6" x 6" and as thick as the first layer of insulation. When the second layer of insulation is applied, the location of the blocks can be indicated with chalk. The electrician can then drive lag screws into the wooden blocks to support the electrical fixtures.

This problem is not difficult, but if ignored can cause trouble on the job. Like so many aspects of low-temperature insulated construction, the best electrical wiring system can be assured by careful planning before the job begins. Armstrong engineers will gladly help you plan your next low-temperature insulation work.

SEND US YOUR QUESTIONS: If you have any questions on the construction of low-temperature facilities, please do not hesitate to write to us. We'll do our best to give you a practical answer. Just address a letter or post card to Armstrong Cork Company, 4412 Concord St., Lancaster, Pa.

ARMSTRONG'S INDUSTRIAL INSULATIONS

MATERIALS - INSTALLATION

FOR ALL TEMPERATURES FROM 300°F. BELOW ZERO TO 2000°F.

Tri-Flex . . . Aerovane

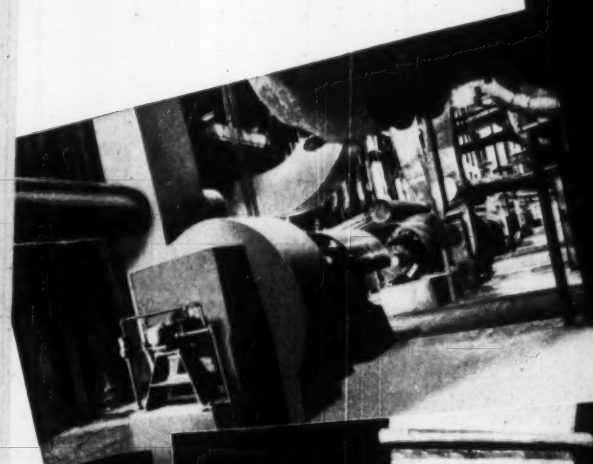
. . in the Crowell-Collier Building

Styled in the best traditions of contemporary architecture . . . designed throughout for utmost efficiency . . . this modern home of the world-known publishers of *Collier's, Woman's Home Companion,* and *The American Magazine* is the latest addition to the New York skyline . . . and like so many other important air conditioned installations from coast to coast, Tri-Flex and Aerovane Grilles and Registers were selected to insure maximum, flexible control of air delivery . . . to meet the most exacting requirements of performance.

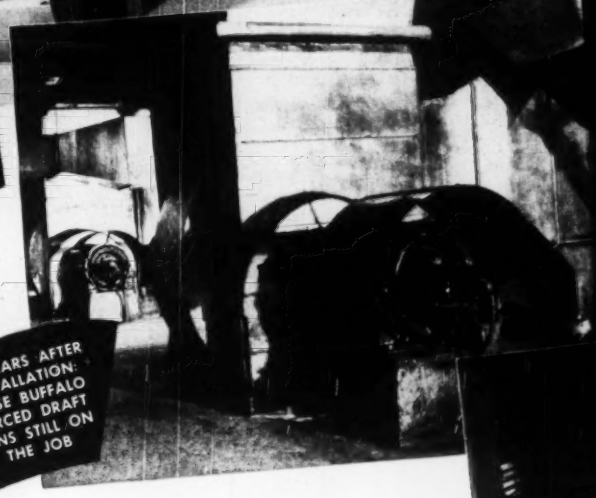
TUTTLE & BAILEY inc

NEW BRITAIN, CONNECTICUT

25-YEAR-OLD "Buffalo" DRAFT FANS PROVE THE ECONOMY of DURABILITY



25 YEARS AFTER INSTALLATION: THESE BUFFALO PRIMARY FANS STILL ON THE JOB



25 YEARS AFTER INSTALLATION: THESE BUFFALO FORCED DRAFT FANS STILL ON THE JOB

25 YEARS AFTER INSTALLATION: THESE BUFFALO INDUCED DRAFT FANS STILL ON THE JOB

Wherever steam is produced for energy, you find a key industry. In every key industry you find "Buffalo" Mechanical Draft Fans represented — and doing a reliable job of keeping boiler combustion efficient.

In the Public Utility companies, where above all, power production must be *continuous*, "Buffalo" Draft Fans are proving that they can be relied on for remarkably long service periods.

The 24 "Buffalo" Draft Fans at Miami Fort Station, Cincinnati Gas & Electric Company, illustrate this durability. They are still in service after 25 years on industry's toughest fan job.

If you want the draft economy that comes only from rugged fan construction in the right places, specify "Buffalo".

WRITE FOR BULLETIN 3750 for all engineering details.

"Buffalo" FIRST FOR FANS

BUFFALO FORGE COMPANY

171 MORTIMER ST. BUFFALO, NEW YORK

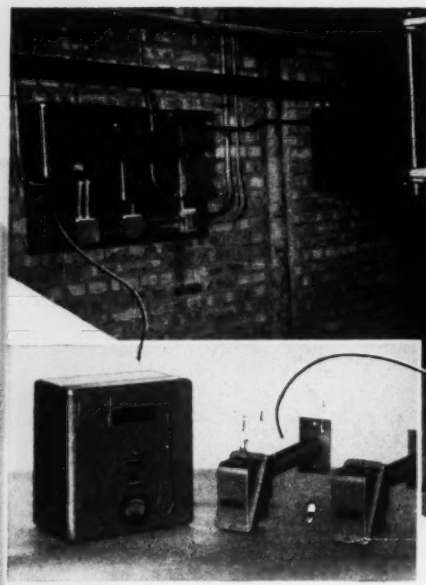
Canadian Blower & Forge Co., Ltd., Kitchener, Ont., Branch Offices in all Principal Cities

VENTILATING FORCED DRAFT | AIR WASHING COOLING | AIR TEMPERING HEATING | INDUCED DRAFT PRESSURE BLOWING | EXHAUSTING

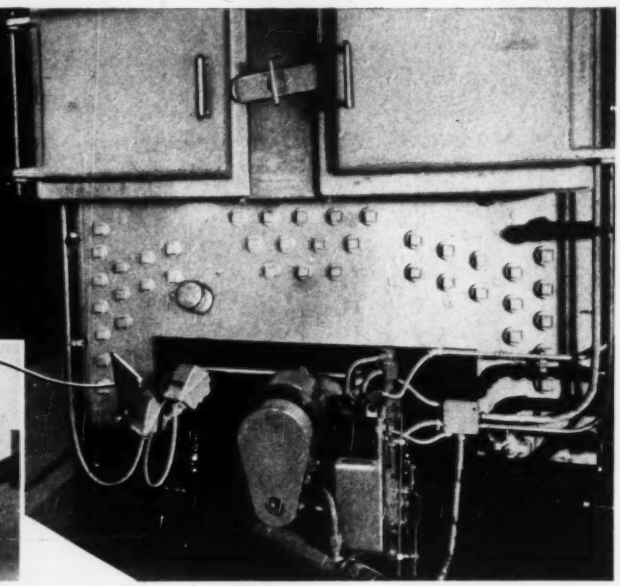
NOW - Commercial Oil Burners

PROTECTED 8 WAYS

With G-E Electronic Oil Burner Control



G-E control components are compact, easily mounted, easily maintained—fully protected.



Photoelectric equipment means fewer moving parts, less maintenance. Here the phototube and electrode units are mounted at the side of the burner. A Tri-Clad* motor and transformer complete the all-General Electric system.

This photoelectric system provides a simple, effective method of controlling and protecting any type of commercial oil burner installation. Simple, easy to install, it offers fail-safe operation for long life, little maintenance. Approved by Underwriters' Laboratories and Factory Mutual.

EVERY FEATURE A PROTECTION FEATURE

1. **Pilot Protection:** oil valve cannot open unless gas pilot has ignited.
2. **Flame Failure Protection:** photoelectric design assures almost immediate closing of oil valve in case of complete flame-failure.
3. **Recycling:** if flame fails after starting, a timed "purging" period prevents immediate restart until explosive gases are cleared from the combustion chamber. The control then automatically recycles.
4. **Cold Oil Protection:** oil temperature thermostat can be used with circuit to assure correct temperature before starting cycle begins.
5. **Power Failure Protection:** program switch automatically recycles before oil valve can open upon return of power.
6. **Motor After-run:** purges nozzle or cup of unburned fuel minimizes carbonizing to reduce field servicing.
7. **Lock-out Indication:** cover light indicates ignition failure. Reset button must be pushed to restart system.
8. **Fail-safe Operation:** self-checking circuit prevents starting unless equipment is in proper condition.

In Addition: General Electric offers both motors and transformers for your commercial oil burner installation designed and time-proved for your equipment. The nearest G-E sales office will give you more information, or write for Bulletin GEA-4779. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

*Reg. Trademark of General Electric Company.

GENERAL ELECTRIC 730-13

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MEET YOUR ALCO ANSWER MEN!

Our Field Engineers will help find the answers to your toughest refrigerant control problems

Are you a manufacturer with a new-product control puzzle?

A service organization with a complex installation job?

Send for your nearest ALCO Field Engineer. He's a good man to know... a specialist thoroughly trained to help you find the most practical, efficient answer.

Just ask us or your jobber for the ALCO Engineering Data Sheet, Form B-3, on which to state your problem. Your ALCO "Answer Man" will do the rest!

A QUARTER-CENTURY OF PIONEERING AND PROGRESS

ALCO VALVE CO.

861 KINGSLAND AVE. • ST. LOUIS 5, MO.

Designers and Manufacturers of Thermostatic Expansion Valves; Evaporator Pressure Regulators; Solenoid Valves; Float Valves; Float Switches.

SEE YOUR ALCO WHOLESALER

4495

INFORMATION ON *Controls* FOR HOT WATER HEATING

Modern uses of hot water heating — for panels, convectors, and baseboards, as well as direct radiation — require up-to-date control systems for maintaining uniform temperature and maximum efficiency. Barber-Colman Company has the necessary controls to handle the various applications properly — and *also* has put together data sheets and descriptive literature to show how these systems work, and what system and equipment to use in any given set of circumstances. This valuable engineering data is available to you free for the asking. Write for yours today — it will surely be a help to you in planning your future hot water heating installations.

BARBER COLMAN

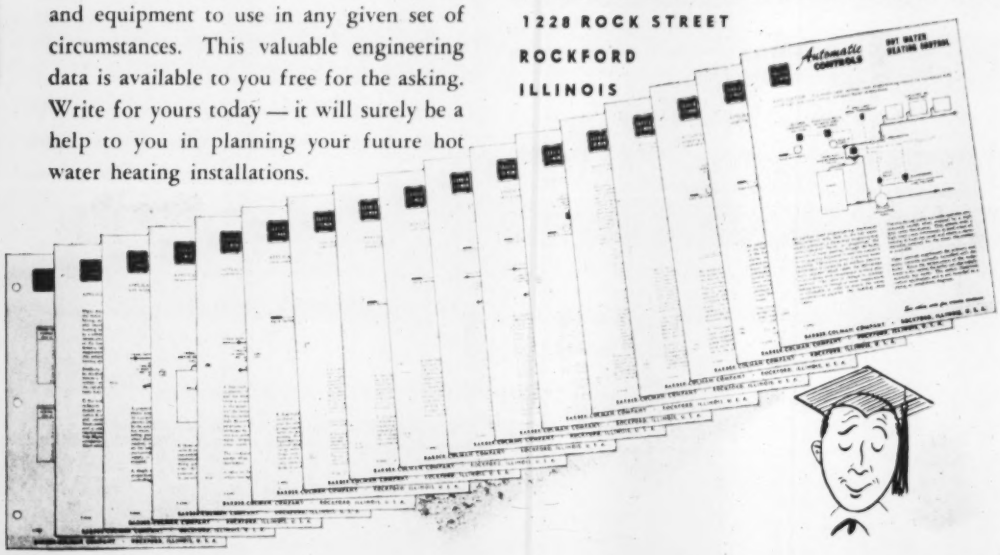
WRITE FOR MANUAL ON HOT WATER CONTROLS TODAY . . .

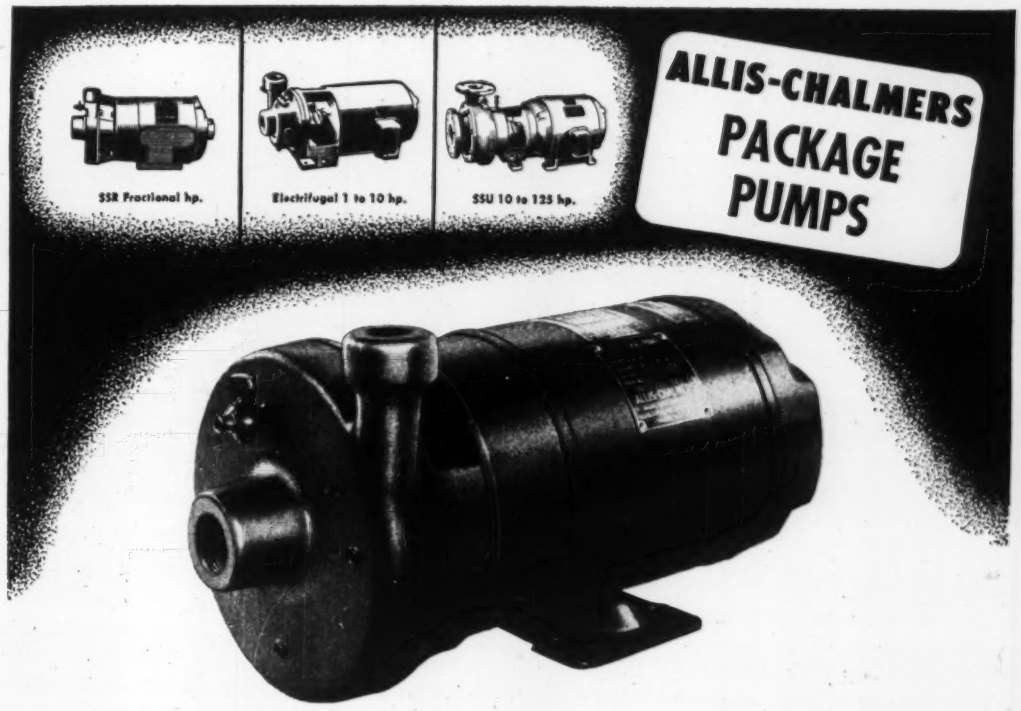
BARBER-COLMAN COMPANY

1228 ROCK STREET

ROCKFORD

ILLINOIS





Competent Installation Engineering Puts Extra Value Into This Pump

WHEN YOU CHOOSE an Allis-Chalmers pump for your air conditioning equipment or installation, the Allis-Chalmers representative goes over the complete installation with you to make sure that you get exactly the pump you need for easy installation and customer satisfaction.

Every Allis-Chalmers pump representative is a skilled application engineer who thoroughly understands your pumping problems. He has a complete line of pumps, both close-coupled and pedestal-mounted for every air conditioning application.

Call in the Allis-Chalmers representative while you are planning your equipment or installation. He may be able to save you time and money by suggesting easier and better ways to install pump or piping. He will be glad to help you in any way he can.

For complete information on Allis-Chalmers pump for air conditioning, ask for Bulletin 52B7529. A-3221

ALLIS-CHALMERS, 1171A SO. 70 ST.
MILWAUKEE, WIS.

Texrope, Vari-Pitch and *Electrifugal* are Allis-Chalmers trademarks.

ALLIS-CHALMERS

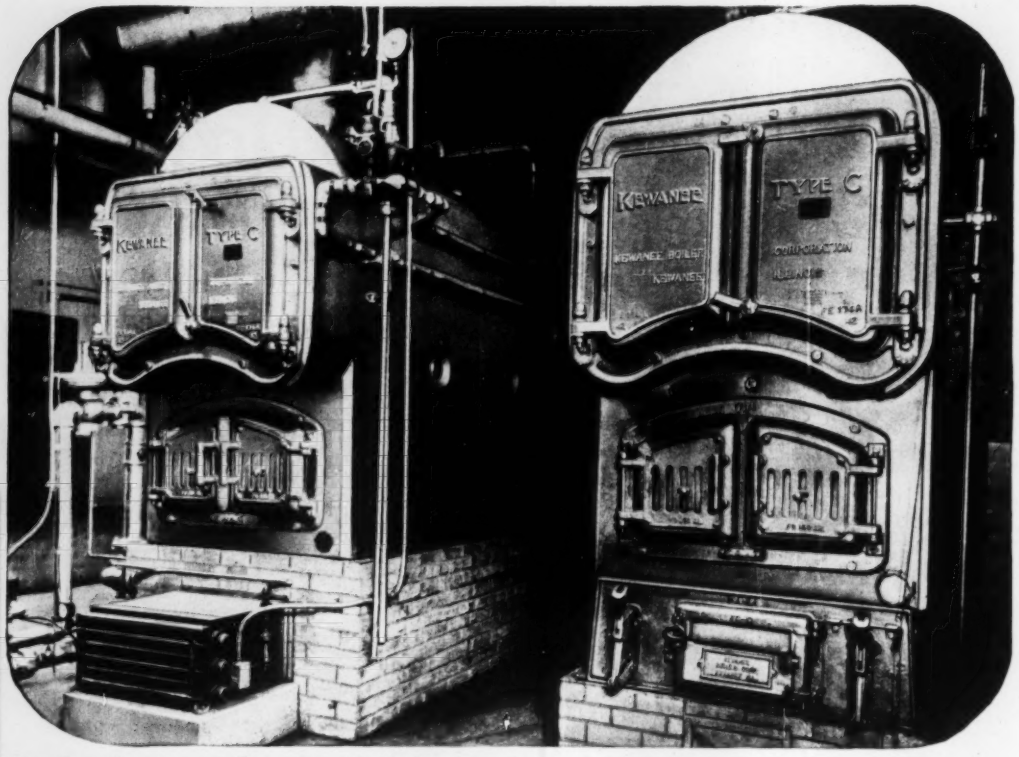
Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.

MOTORS — ½ to 25,000 hp and up. All types.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE — Belts in all sizes and sections, standard and *Vari-Pitch* sheaves, speed changers.



Mechanical and/or Hand Firing . . .

The type of fuel makes no difference to

KEWANEE
STEEL BOILERS

SALVATION ARMY BARRACKS
Toledo, Ohio
Horace Wachter, Architect
Forster, Wernert & Taylor, Engineers
Dan MacDermid, Heating Contractor

Note this versatility:—one Kewanee Type "C" gas-fired producing 1,459,000 Btu per hour and its hand-fired companion with an hourly output of 1,200,000 Btu.

Whether the preference is for Oil, Gas or Coal Kewanee may be specified with assurance that it will get the best from any fuel whether the boiler be hand-fired or teamed-up with any good burner or stoker.

As with all Kewanee Boilers a change from one fuel to another . . . or from mechanical to hand firing, or back again . . . involves no change in the boiler proper. This versatility means much in times when a shortage of any particular fuel may occur.

KEWANEE BOILER CORPORATION

BOILERMAKERS 80 YEARS KEWANEE, ILLINOIS

Branches in 60 Cities—Eastern District Office: 40 West 40th Street, New York City 18

Division of American Radiator & Standard Sanitary Corporation

Serving home and industry

AMERICAN-STANDARD · AMERICAN BLOWER · CHURCH SEATS · DETROIT LUBRICATOR · KEWANEE BOILERS · ROSS HEATER · TONAWANDA IRON

A PROBLEM
IN
Beauty and Balance

The cafeteria of a large insurance company in New York City • **Architect:** T. H. Engelhardt • **Engineer-Contractor:** Buensod-Stacey, New York, N. Y.

...solved by **kno-draft** adjustable air diffusers

The air-conditioning problem in this company cafeteria was to select air diffusers that would "go" with its rich design and, at the same time, balance the great heat differential between the serving and the dining area.

Kno-Draft *Adjustable* Air Diffusers solved both problems.

Notice how well Kno-Draft's clean, concise lines harmonize with paneling and chandeliers. Take a satisfied user's word for it that the pattern of air flow provides equalized temperature and thorough distribution—*without draft*—throughout the entire area.

With Kno-Draft *Adjustable* Air Diffusers, both air volume and direction are completely and easily controlled *after* installation. A screw driver is the only tool needed. Kno-Draft Air Diffusers are as much "at home" in modern as in traditional surroundings . . . and there are types and sizes to meet every requirement.

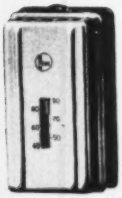
KNO-DRAFT DATA BOOK: Complete specifications, engineering and installation data on Kno-Draft *Adjustable* Air Diffusers. To get your copy, simply fill in and mail the coupon. No obligation, of course.

W. B. CONNOR ENGINEERING CORP.
Danbury, Connecticut
Air Diffusion • Air Purification • Air Recovery
In Canada: Douglas Engineering Co., Ltd.,
190 Murray Street, Montreal 3, P. Q.

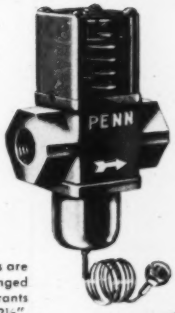
W. B. CONNOR ENGINEERING CORP.
Dept. G-120, Danbury, Connecticut
Please send me, without obligation, my copy of the Kno-Draft Air Diffuser Data Book.

Name.....
Position.....
Company.....
Street.....
City.....**Zone**....**State**.....

Penn 270 Series temperature and pressure controls incorporate 2-pole construction and a direct-reading calibrated scale which shows both cut-in and cut-out points.



Penn Unit Heater Thermostat features "heat anticipation" and a built-in "on-off" switch. Cooling Thermostats and Humidistats are also available in the Penn line.

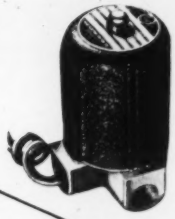


Series 246 Water Valves are built in threaded and flanged styles for all refrigerants and in sizes from ⅜" to 2½".

TRY 'EM!

then you'll use them on every refrigeration job

Penn Series 221 Solenoid Valves are direct acting and may be used with all non-corrosive refrigerants as well as for water, oil or air.

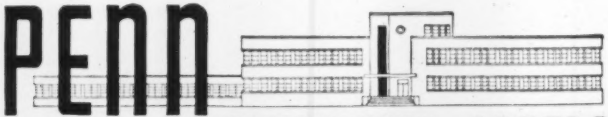


Penn Magnetic Line Starters are built in NEMA sizes 0, 1 and 1½ and are available as open-type models for control panels or with General Purpose enclosures.

There is a difference in automatic controls . . . a difference in the degree of their efficiency, dependability and long-life accuracy! And once you try PENN controls . . . you'll learn that their performance on the job is the strongest recommendation for using PENN on every air conditioning, refrigeration and space heating application.

Featured in the air conditioning and refrigeration line is the famous 270 Series . . . the first and only control in these fields to have a load-carrying, two-pole contact structure. It gives you two switches in one! It controls multiple refrigeration systems . . . it controls two separate load circuits . . . it controls polyphase motors without the use of line starters (where protection is provided against single phasing).

Take the first step in trying these better controls. Get the *new* PENN Condensed Catalogs . . . one on heating and the other on refrigeration controls . . . they're FREE. Ask your wholesaler or write **Penn Electric Switch Co., Goshen, Ind.** Export Division: 13 E. 40th Street, New York 16, U.S.A. In Canada: Penn Controls, Ltd., Toronto, Ont.



AUTOMATIC CONTROLS

FOR HEATING, REFRIGERATION, AIR CONDITIONING, PUMPS, AIR COMPRESSORS, ENGINES, GAS RANGES

Someday... dreams come true...

A Merry Christmas

For a boy of eight, Christmas dreams often come true! Today, a dream rests in all our hearts... placed there almost two thousand years ago... a dream of "Peace on Earth—Good Will Toward Men."

Someday... someday *soon*, we pray... this dream, too, will come true.

WHEATLAND TUBE COMPANY
Bankers Securities Bldg., Philadelphia 7, Pa.

A CURTIS Franchise is MONEY IN THE BANK

BECAUSE CURTIS EQUIPMENT

SELLS and STAYS SOLD

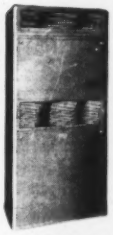
AND YOU CAN HANDLE ANY...

AIR CONDITIONING • REFRIGERATION • or AIR MOVING JOB

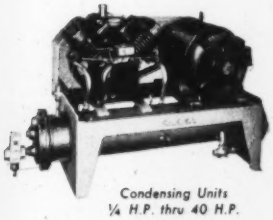
WITH THE COMPLETE CURTIS LINE

With the addition of new 2, 3 and 8-ton package type and 30 and 40-ton remote type air conditioners to the comprehensive Curtis line, the Curtis dealer is in his best position in history. Long known for their performance record, Curtis Packaged Air Conditioners are built to operate efficiently with minimum installation and maintenance costs.

Supported with big, colorful full page advertisements in the Saturday Evening Post, Time, Newsweek and many other consumer magazines, plus an assortment of powerful sales promotion helps, the Curtis dealer will find Curtis equipment is recognized and wanted by consumers everywhere.

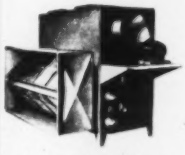


Packaged Type
2½ to 8 tons



Condensing Units
¼ H.P. thru 40 H.P.

Central Type
10 and 15 tons



Ceiling and Floor Type
Air Handling Units

Evaporative Condensers,
and Cooling Towers
to Match

CURTIS Refrigerating
Machine Division
of Curtis Manufacturing Company
1950 Kienlen Avenue, St. Louis 20, Mo.

96 YEARS
of
SUCCESSFUL
MANUFACTURING

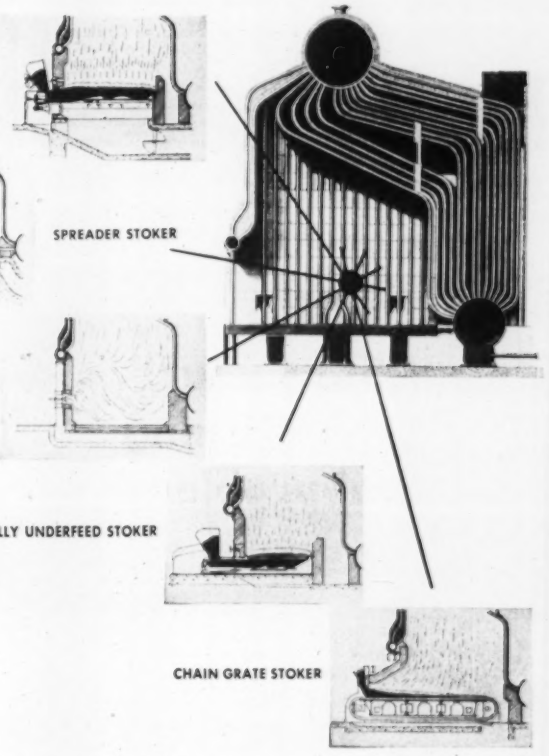
For every fuel market and every type of load there is *one best* method of firing. The selection of that *one best* method for the fuel and load conditions of a particular plant calls for judgment based on broad experience and free from any incentive to favor one type of fuel burning equipment over another.

The Type VU-10 Boiler is designed for five fully standardized methods of firing—spreader stoker, single-retort underfeed stoker, chain grate stoker, oil or gas burners. The furnace design is such that any of these methods may be substituted for any other should a change in the fuel market make it advantageous.

C-E Vertical-Unit Boiler

TYPE VU-10

Capacity — 10,000 to 60,000 lb of steam per hr.



Why buy a Boiler Unit piecemeal?

A piecemeal boiler unit is one in which some of the major components are purchased from different manufacturers.

There is no assurance . . . certainly no protecting guarantee . . . that the resulting assembled compromise will meet your performance requirements. If you buy piecemeal, you must accept the uncertainties inherent in divided responsibilities for overall results.

That is why it will pay you to investigate the Vertical-Unit Boiler, Type VU-10. Here is a completely integrated unit . . . boiler, water-cooled furnace, setting and fuel burning equipment . . . available from one manufacturer — Combustion Engineering—Superheater — a recognized leader in both the fields of fuel burning and steam generation. From the initial design stage, the relationship of each of the components, one to the other, has been so developed as to provide the highest possible degree of correlation and standardization. And . . . of prime importance to the buyer . . . the overall performance is underwritten by the C-E sales policy of "one contract, one guarantee, one responsibility."

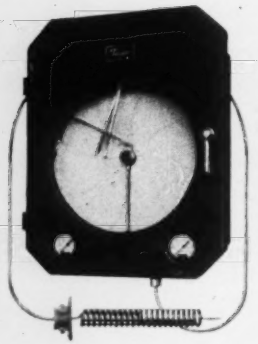
So — buy *your* next boiler as a *complete* unit . . . the VU-10. Enjoy the peace of mind that comes from the knowledge that you have an installation for which one manufacturer — Combustion Engineering—Superheater — is responsible for fulfillment of performance guarantees. Moreover, you will be able to count upon a reliable source for whatever service or spare parts you may require during the many years that represent the useful life of a modern steam generating unit.

B-440B

COMBUSTION ENGINEERING—SUPERHEATER, INC.

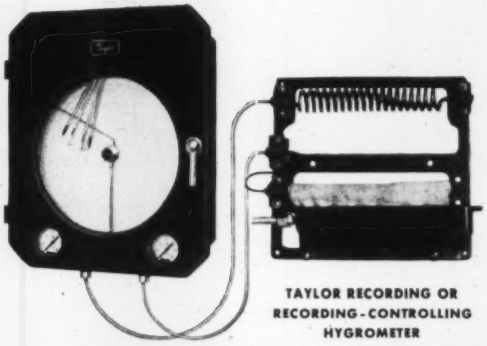
200 Madison Avenue • New York 16, N. Y.

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS. ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS



TAYLOR FULSCOPE* TEMPERATURE CONTROLLER

Regulates diaphragm valves and lever motors for operation of dampers, etc., to make your air conditioning system work smoothly. Automatically compensates for load changes. Controls refrigeration compressors. Gives you automatic seasonal changeover.



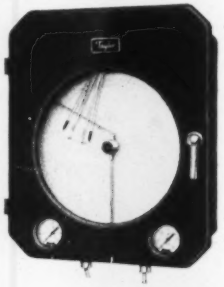
TAYLOR RECORDING OR RECORDING-CONTROLLING HYGROMETER

With continuous water feed. Ideal where air circulation is good, and panel is well located within apparatus, room or duct for best circulation across bulbs. Available with constant level or bottle-fed water reservoir.

What's *your* air conditioning control problem?

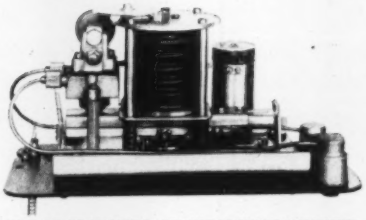
DO you need a single control instrument for an isolated application? Or complete controls for a complete air conditioning system?

Taylor makes a full line of accurate control instruments for every air conditioning need. We'll be glad to work with you or your consulting engineers or contractors to give you the instruments best suited to your individual problem. Ask your Taylor Field Engineer or write Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.



TAYLOR FULSCOPE* RATIO RECORDING CONTROLLER

Ideal where you need control in one medium in a definite relationship to some other variable medium . . . such as inside temperature control in summer air conditioning according to variable outdoor temperatures.

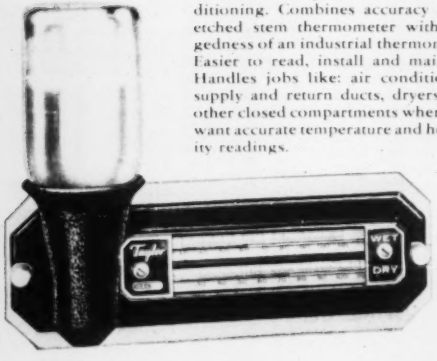


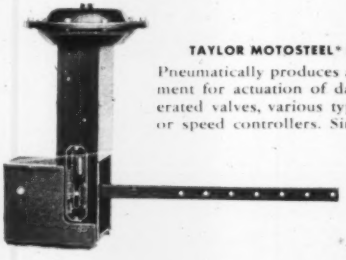
TAYLOR TRANSAIRE* TEMPERATURE TRANSMITTER

New force-balance pneumatic transmitter that meets all normal air conditioning requirements with Simple Operation, Positive Transmitting action and Rapid Response to Temperature Changes. Ideal where zones are remotely located from centralized control room.

TAYLOR 10BG HYGROMETER

With bottle-fed reservoir. Perfect for more accurate spot checks on air conditioning. Combines accuracy of an etched stem thermometer with ruggedness of an industrial thermometer. Easier to read, install and maintain. Handles jobs like: air conditioning supply and return ducts, dryers, and other closed compartments where you want accurate temperature and humidity readings.





TAYLOR MOTOSTEEL* LEVER MOTOR

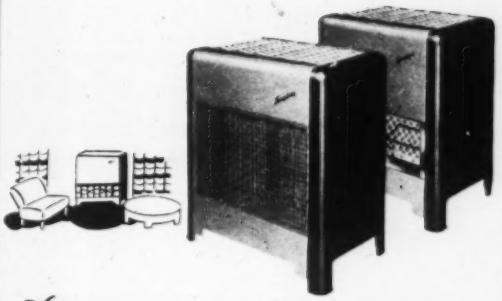
Pneumatically produces a thrusting movement for actuation of dampers, lever-operated valves, various types of governors or speed controllers. Simple, low-priced.

*Registered Trade Mark

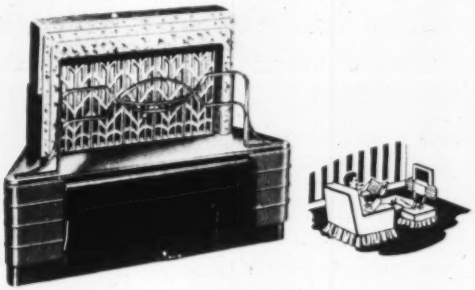
THE *Humphrey* LINE

...GAS HEATING AT ITS BEST!

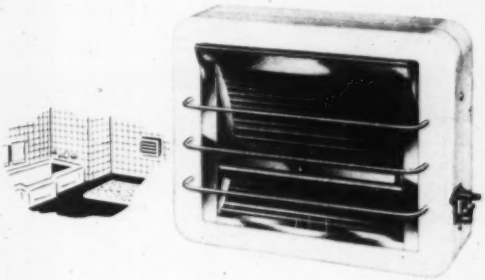
You can sell Humphrey Gas Heating equipment with confidence that you are giving your customers complete satisfaction in styling, heating performance, and economical operation.



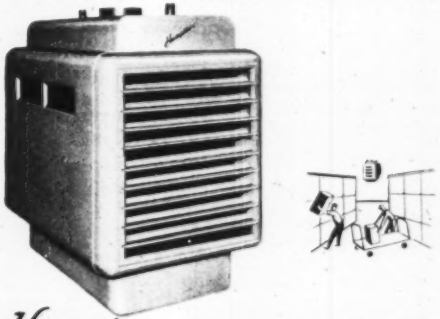
Humphrey **CIRCULATORS** Unsurpassed in ability to produce fast, clean heat . . . modern, beautiful styling . . . low cost operation. Two models . . . Open front Radiantfire Circulators and Closed front Royaline Circulators. Manual or automatic operation.



Humphrey **RADIANTFIRES** One of the most popular gas heaters ever made . . . abundant, satisfying heat with all the cheerfulness of an open fire. Available in vented and unvented models . . . manual or automatic operation.



Humphrey **WALL HEATERS** Ideal for bathroom, sunroom, den, playroom and many other places where economical auxiliary heat is needed. Designed for your choice of mounting — recessed in the wall or mounted on the wall. Easy to install.



Humphrey **AUTOMATIC GAS UNIT HEATERS** Completely "packaged" circulated heat for stores, shops, restaurants, garages, factories, etc. No boiler room equipment or fuel storage. Exclusive Humphrey construction assures maximum heat output at lowest fuel cost. A size for every need.

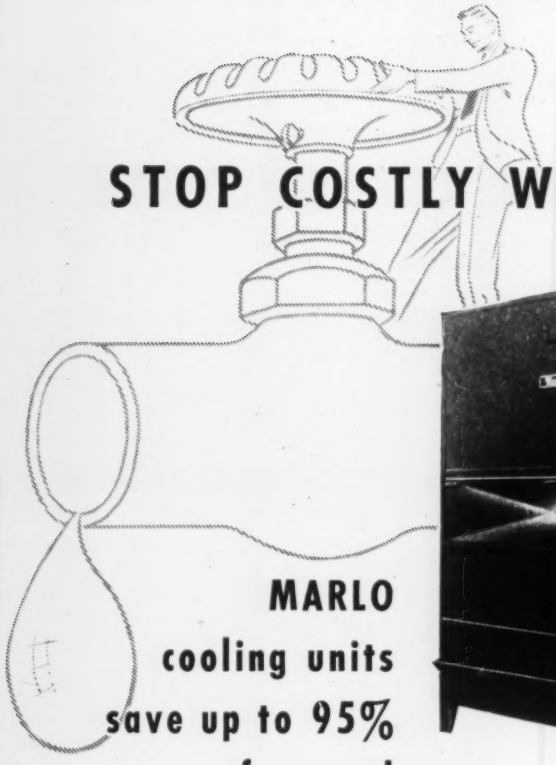
There is no substitute for experience. For more than fifty years we have been designing and building gas heating equipment *exclusively* . . . that is why there is no finer line of gas heating equipment made.

A HUMPHREY PRODUCT

GENERAL GAS LIGHT COMPANY

KALAMAZOO, MICHIGAN

23 Warren St., New York City • 2nd Unit Santa Fe Building, Dallas
225 Eleventh St., San Francisco



STOP COSTLY WATER WASTE!

MARLO cooling units save up to 95% of normal water demand

. . . assure better installations for you!

Water must be used *wisely*.

By efficient **recycle cooling,** Marlo Evaporative Condensers and Cooling Towers get the most out of every drop . . . actually conserve up to 95% of the normal demand for cooling. Your clients will appreciate this saving . . . and these other Marlo PLUS-features too . . .

• **QUIETNESS** . . . No roar of blower blades. Marlo Units feature silent V-belt drive . . . sound deadening interiors.

• **DEPENDABLE PERFORMANCE** . . . Exclusive Marlo **"Lektro-Tektor"** sump tank unit guards against electrolytic corrosion. Frame, sump tank, eliminators, wheels and scrolls are **hot dip galvanized.**

★ ***Write for information on Marlo Evaporative Condensers and Cooling Towers.***

MARLO • HEAT TRANSFER
Since 1925

Marlo COIL CO. • 6135 Manchester Rd. • St. Louis 10, Mo.

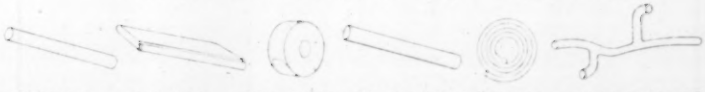
A TYPICAL REPORT:
"The recommendation of an H+H automotive tubing buyer prompted us to buy our refrigeration tubing from H+H."
H&H means Quality and savings and Service in Brass and Copper Tubing

One tubing buyer tells another, and the result is another customer who will some day buy his tubing from H & H. Whether you buy for automotive, refrigeration, or other purposes, always remember that H & H has the right tubing for you, subject only to its ability to meet demand. You can buy no better refrigeration tubing than that pictured above, dehydrated and sealed under positive control. And so it goes. When it's quality, savings and service you want, remember, you can never go wrong with H & H.

Originators and sole makers of "Metalflo"— the economy tubing

H & H TUBE AND MANUFACTURING COMPANY

246 N. Forman Avenue • Detroit 17, Michigan • VInewood 2-3600



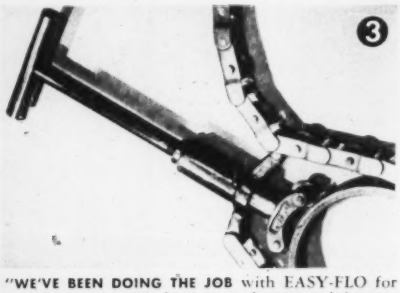
METALFLO • LOCKSEAM • COIL STRIP AND SEAMLESS TUBING • TUBULAR PARTS

The case of the cast iron PIPE CUTTER

—as related to us by an executive of Springload Mfg. Corp., Seattle, Washington.

"WHEN WE STARTED making this cutter, one main problem was finding a way to attach a machined bar to a piece of tubing, and adding a T handle to the tubing.

"WHAT MADE THE PROBLEM more tricky, the joints had to take severe stresses—both rotary and tensional. It was without solution until your representative demonstrated EASY-FLO low temperature silver alloy brazing.



"WE'VE BEEN DOING THE JOB with EASY-FLO for over two years now. It gives us the strong joints we need and also meets all our production requirements.

"THESE TOOLS CUT cast iron soil pipe, water pipe and Duriron pipe from 2" to 12" sizes. They're very easy to use, cut clean and true and much faster than other methods.

"ALTHOUGH THERE ARE many thousands of these tools out and they are usually used under rough conditions, we have yet to encounter any difficulty from the EASY-FLO brazed joints."

The Same Service Is Yours—Anytime

■ We maintain a corps of thoroughly trained and experienced specialists just to show manufacturers what our low-temperature silver brazing alloys can do on their work and to help solve specific problems. We'll be glad to send one to your shop—anytime—without cost or obligation. The new BULLETIN 20 gives the full story about the alloys and the valuable services that go with them. Write for a copy today.

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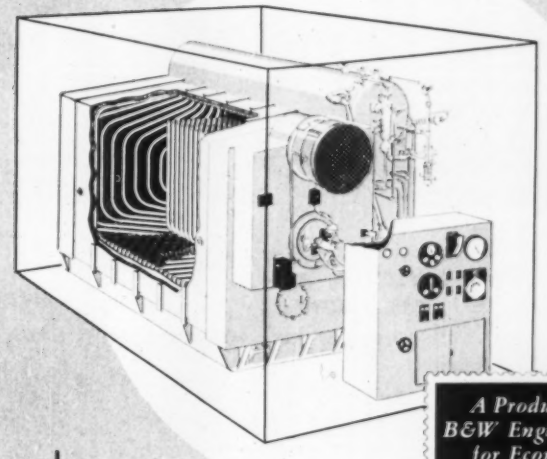
NOW

Big boiler advantages "wrapped up" in NEW COST-SAVING B&W SHOP ASSEMBLED UNITS

B&W Integral-Furnace Boiler, TYPE FM



A Product of B&W Engineering for Economy

Cost-Saving Features of the New B&W Integral-Furnace Boiler, TYPE FM

- Saves Erection Time and Cost
- Meets Wide Range of Services
- Handles Quick Load Changes
- Fast Steaming
- Low Maintenance
- Easy Accessibility
- Suitable for Outdoor Service
- Burns Oil and/or Gas
- Saves Fuel
- Saves Space
- Safe, Automatic Operation

Here at last is the ideal combination for efficient, low-cost "packaged" steam: the new B&W Integral-Furnace Boiler, Type FM. It combines the many advantages of factory-assembled boilers with the service-proved economies of B&W Integral-Furnace construction. It's delivered fully-equipped for immediate operation.

Of prime importance is the fact that this new B&W boiler embodies design, construction, and operating features that have made larger capacity Integral-Furnace units such a heavy favorite among industrial plants and central stations.

Small and medium size plants, institutions, and commercial establishments will find this new unit the ultimate in low-cost heating and process steam-generation from 3,000 to 35,000 lb. per hr. at pressures to 250 psi. Large plants, too, where space and load characteristics warrant, may profitably consider several packaged boilers instead of a single "tailor-made" installation.

Engineered, designed and built under a single responsibility, the new Integral-Furnace Boiler, Type FM is backed by the same tradition of service satisfaction that has made B&W a by-word in low-cost steam generation for more than 80 years.

Helping Industry Cut Steam Costs Since 1867

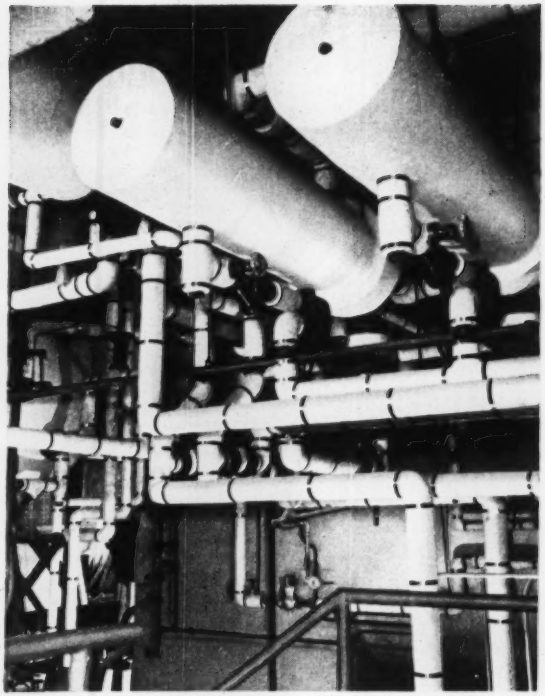
BABCOCK & WILCOX

Send for Bulletin G-72, detailing the many advantages of this new B&W creation in low-cost steam generation.
The Babcock & Wilcox Company, 85 Liberty Street, New York 6, N. Y.

G-306

NOW! KEEP HEAT WHERE IT'S WANTED WITH THESE K&M INSULATIONS

Here you see two popular K&M Pipe Insulations— ***K&M DUPLEX*** *and* ***K&M "FEATHERWEIGHT"® 85% MAGNESIA*** *—used on the hot water supply and steam lines in a modern hospital. Consider what these K&M insulations can do for you:*



Efficient K&M Insulations on the job in a modern hospital.

K&M DUPLEX PIPE INSULATION—

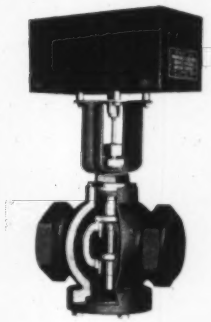
Effective insulation for temperatures between 40°F. and 212°F. Use it for both hot and cold water pipes—one insulation for both uses simplifies stocking. K&M Duplex is formed of a continuous wrapping of specially creped felt, which forms countless heat-holding dead-air pockets. An inner liner of felt is saturated with a special waterproofing compound—condensation or seepage can't get through to damage the insulating layers. Single-layer K&M Duplex comes in thicknesses of $1\frac{1}{2}$", $\frac{3}{4}$", and 1"; and in sizes to fit all standard pipes. Double-layer K&M Duplex is furnished in thicknesses of 1", $1\frac{1}{2}$", and 2". Supplied complete with canvas jacket and necessary brass lacquered bands. K&M Duplex is easy to cut and fit on the job—is easily and quickly erected.

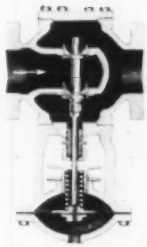
K&M "FEATHERWEIGHT" 85% MAGNESIA PIPE INSULATION—For temperatures to 600°F. Here's the insulation for your low-pressure steam lines! K&M 85% Magnesia combines the high insulating properties of basic carbonate of magnesia, properly compounded with clean asbestos fibers. It's exceptionally light and extremely efficient—is mechanically strong and durable enough to withstand all ordinary usage. Thicknesses: Standard, $1\frac{1}{2}$", 2", Double Standard (broken joint), and 3" (broken joint). Comes complete with canvas covering and brass lacquered bands. Use K&M 85% Magnesia Insulation for hot pipes needing a highly efficient, long lasting covering.

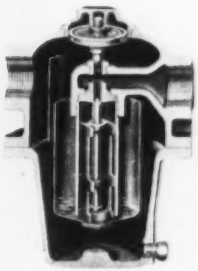
Get the complete story: Your K&M Distributor will be glad to give you further information on K&M DUPLEX, K&M "FEATHERWEIGHT" 85% MAGNESIA, or any of the other efficient pipe insulations in the K&M line. Consult him without obligation, or write us.

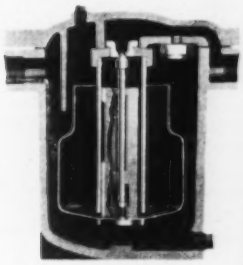
Nature made Asbestos . . .
Keasbey & Mattison has made it serve mankind since 1873.

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA





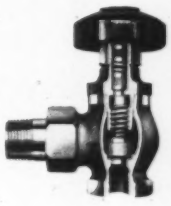


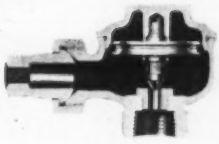


ILLINOIS

Automatic

Steam and Fluid Control Equipment





Illinois Control Equipment includes Combustion Control, Flow Control (electrical or pneumatic), Zone Control and a complete line of steam heating and power specialties for heating comfort and fuel saving and for industrial process control as well.
"ILLINOIS" is your logical, dependable source of supply for heating and power specialties that have been carefully engineered, thoroughly proved and have a performance record that is beyond question.
Our representative nearest you in our nation-wide service will give you full information.

Write for Bulletins

ILLINOIS ENGINEERING COMPANY
INCORPORATED 1900
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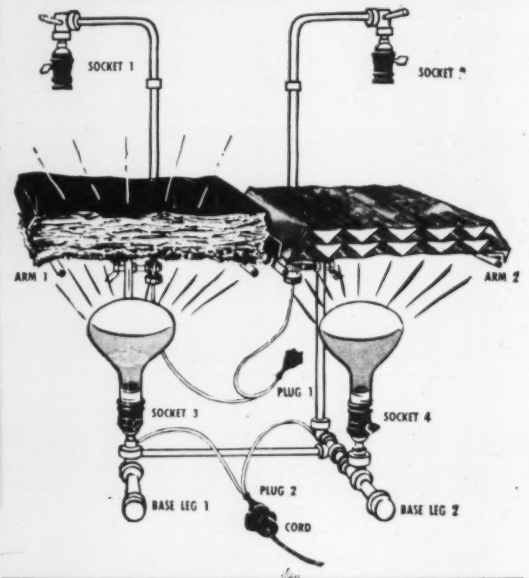
Why don't you yourself test and compare the various thermal insulations in the privacy and convenience of your own office?

We will send you for 2 weeks' free use a simple, compact, practical and efficient heat-flow tester, with samples of mass insulations, and multiple sheet accordion aluminum insulations. Put it on your desk, plug it in, and make your tests for DOWN-HEAT FLOW, UP-HEAT and WALL-HEAT. Test other insulations of your own choice.



Multiple sheet accordion aluminum cellular insulation is also completely impervious to vapor, will not form condensation nor retain moisture. Its ZERO permeability will force out fortuitous vapor. Safeguards against moisture damage; is an efficient fire stop.

Please refer to revised *"Simplified Physics of Vapor and Thermal Insulation"* for more information on heat and vapor flow, and on the various thermal insulations. FREE COPY accompanies every tester. To get only this manual, without tester, check indicated square in coupon and mail.

THERMAL FACTORS, INFRA TYPE 6

Down-Heat	C.044, R 22.72	= 7½" dry rockwool
Up-Heat	C.080, R 12.50	= 4" dry rockwool
Wall-Heat	C.073, R 13.69	= 4½" dry rockwool

Costs less than 9¢ sq. ft., material with labor, between wood joists in new construction.

TEST FOR UP-HEAT FLOW

Infra Insulation, Inc.,
10 Murray St., New York, N.Y. Dept. H-12

Please send HEAT TESTER for 2 weeks. Not responsible for any damage to it.

☐ Send only "Simplified Physics of Vapor and Thermal Insulation," NO tester

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THE EDITOR'S PAGES

• NEXT MONTH, the January issue of HPAC will be a big one, with a number of special features. . . . . A complete Directory Section of Heating, Piping, and Air Conditioning Equipment for Industrial, Commercial, Institutional and Public Buildings, thoroughly revised and brought up-to-date, will appear for the 17th consecutive year. . . . Exhibits at the International Heating, Ventilating & Air Conditioning Exposition, to be held in Philadelphia January 22-26, and other details of the big show and the annual meeting of the American Society of Heating and Ventilating Engineers, will be "previewed" in a special Show Section. . . . These features are in addition to HPAC's regular editorial content, including the Journal Section of the ASHVE. . . . It all adds up to an issue we know you'll particularly like. . . . Until then, best wishes for a Merry Christmas and a Happy New Year!

SEE 19 PERCENT DECLINE IN 1951 CONSTRUCTION

BUILDING AND engineering contracts will decline 19 percent in 1951 relative to 1950 in the 37 states east of the Rockies, it is estimated in the annual November outlook of F. W. Dodge Corp., as published in Architectural Record.

The estimates are authored jointly by Thomas S. Holden, president of Dodge, and Clyde Shute, assistant vice president in charge of the statistical and research division.

"This is a cut-back from the peak construction volume of all time," they state. "It leaves a dollar total measurably greater than that of any year except 1950, and a physical volume total that would compare favorably with other prosperous construction years.

"We question whether there will be much change in the level of construction costs in 1951," they say. "Some materials will be tight; others which were tight in 1950 will be plentiful and competitively priced. Demand for building labor will ease somewhat with reduced construction volume, though doubtless many men who have been employed in construction in 1950 will shift to defense production."

The Dodge estimate is that combined residential and nonresidential contract valuations in the 37 states in 1951 will decline 24 percent relative to 1950, but that public and private works and utilities, also known as heavy engineering, will remain at the same dollar total, to bring the total of all construction down 19 percent. The estimate is that nonresidential building will decline 10 percent, and residential 35 percent.

"It must be emphasized, however," they conclude "that the possibility of sudden, unexpected, drastic action by government greatly augments the customary hazard of guessing future construction activity. More than ever it is necessary for those who make or follow advance construction estimates to review and revise their figures frequently."

INDEX FOR 1950 TO BE AVAILABLE ON REQUEST

AN INDEX for HPAC's 1950 issues, Vol. 22, Nos. 1-12, including the Journal Section of the American Society of Heating and Ventilating Engineers, is being compiled and will be available soon to HPAC's subscribers on request. If you want a free copy, send a note or postcard to the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

We'll keep your request on file until the index has been printed, and will then mail a copy to you.

SWITCH FROM DECEMBER 31 CLOSING DATE TO SAVE

BUSINESS MEN could save time and money if they switched from December 31 as a date for closing their books to a fiscal year ending when their business activities are at a seasonal low point, Edward Mezner writes in the November Journal of Accountancy, official publication of the American Institute of Accountants.

Even if a company has no well-defined "natural business year," Mr. Mezner — a certified public accountant — believes it can benefit from a closing date other than the last day of the calendar year. Among the disadvantages of a December 31 closing date, he says, are the following:

1) Midwinter weather is usually bad and this increases the cost of stocks to be checked are stored out-inventory taking especially when the doors.

2) Since January and December are months when many government reports must be prepared and statements of earnings furnished to employees, bookkeeping staffs are usually heavily burdened with work.

3) Most accounting firms are extremely busy at this time.

4) Banks are also "engulfed by the mad January rush." They could devote more study to the business man's credit and other problems at another date.

BOILER AND RADIATOR SALES SET POSTWAR RECORD

STANLEY K. SMITH, president of the H. B. Smith Co., was elected chairman of the Institute of Boiler and Radiator Manufacturers at the 35th annual meeting last month. Attendance was the largest in IBR history.

Wesley J. Peoples, president of the United States Radiator Corp., was named the vice chairman. R. E. Ferry is the general manager and treasurer of the IBR.

The volume of sales of cast iron boilers, radiators and baseboards in 1950 is the highest for any postwar year, it was reported at the meeting. General optimism for a continued high level of sales was expressed, the only qualification being the possibility of material shortages.

A report on the IBR research program at the University of Illinois was presented by Warren S. Harris, special research associate professor. He said that the institute will soon publish a booklet describing simplified piping methods for hot water heating developed at the U. of I. in connection with the research program. These shortcuts not only result in better operation of the system but also effect substantial reductions in the cost of installation.

During 1951 a study of piping and

pickup factors for a one pipe hot water heating system will be carried on at the university. A study will be made of baseboards to see if they will operate efficiently when installed under the ceiling.

HOW TO REPLACE BROKEN BOLTS

REPLACING BROKEN bolts is often a tough maintenance problem. Whether the bolt breaks off above or below the surface, the broken portion must be removed, the hole retapped and a new bolt inserted.

With a stud welding gun, however, it's a much simpler job, according to the Nelson Stud Welding Div. of the Morton Gregory Corp. No drilling or tapping is required—the stud is simply end welded in place after minor surface preparation.

Bolt replacement time has been cut from 20 to 5 minutes by this method. If a bolt breaks off above the surface, it is first cut off flush. The stud is then end welded directly over the imbedded portion of the original bolt. When the bolt breaks off below the surface, the hole is first filled with weld metal before the stud is end welded in position.

SIMPLE MEASURES CAN CUT SMOKE BILL IN HALF

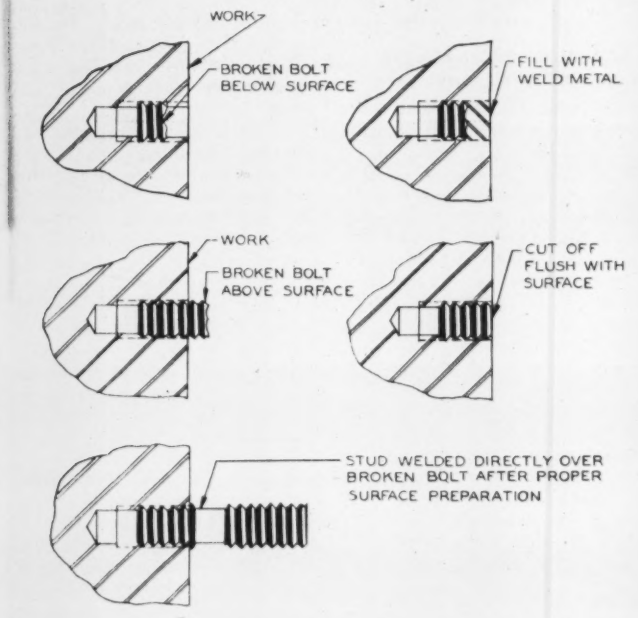
AMERICAN CITIES' $3½ billion smoke bill could be cut in half in the next four or five years largely by simple efficiency measures in firerooms of smoke-offending buildings, according to studies of the Anthracite Institute's smoke prevention clinic.

According to E. E. Finn, clinic director, "smoke can be virtually eliminated, and not only would the individual citizen benefit but so would the offender because smoke is actually wasted fuel."

Smoke originates in heating or power equipment if the fuel is not right, if the equipment is not right for the fuel being used, or if combustion conditions are not right, he said.

Mr. Finn pointed out that recent studies by New York City's bureau of smoke control showed that effective control in that city alone would save residents at least $50 million a year. Fuel savings by themselves would account for $8 million of this, the study revealed. Other savings taken into consideration were painting and decorating, laundry and dry cleaning, extra lighting costs, spoilage of store goods, repairs to buildings (such as replacement of sheet metal gutters), renewal of household drapes and curtains, drugs and doctor bills.

The smoke prevention clinic was established more than a year ago by the Anthracite Institute as a public service to assist building owners in eliminating smoke and in saving money through more efficient operation of heating plants. It has a staff of heating engineers who operate out of the clinic's headquarters at 101 Park Ave., New York City.


WORK
BROKEN BOLT BELOW SURFACE
FILL WITH WELD METAL
WORK
BROKEN BOLT ABOVE SURFACE
CUT OFF FLUSH WITH SURFACE
STUD WELDED DIRECTLY OVER BROKEN BOLT AFTER PROPER SURFACE PREPARATION

INDUSTRIAL HYGIENE YIELDS MANY BENEFITS

SOUND INDUSTRIAL hygiene programs yield both financial and goodwill dividends to plant managements, Frank A. Patty of General Motors research laboratories said at a recent meeting of the American Public Health Association's industrial hygiene section. Industrial hygiene's key mission, he emphasized, is to protect plant employees, reduce occupational disease to the point of rarity.

Reporting on a survey of industrial hygiene costs, Mr. Patty said they varied from less than 50c to $2.50 per employee per year. Such figures, he emphasized, could not be considered standards because cost of industrial hygiene programs depend entirely on the nature of the industry.

"These figures represent a very modest sum when compared to medical costs of $6 to $30 and safety costs of $1.50 to $66 per employee per year in the group of industries surveyed," he said.

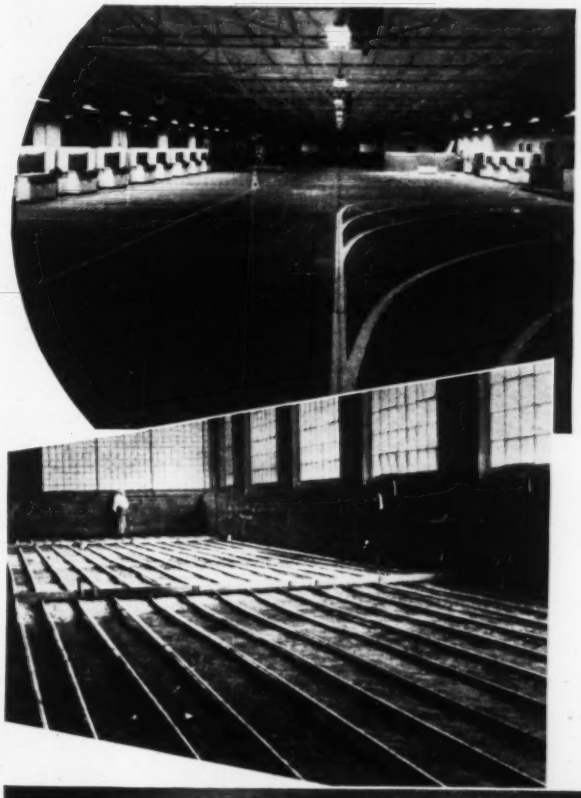
BREAD TIES WAGES TO LIVING COST

BY PAYING EMPLOYEES in the dollar equivalent of a specified number of 1 lb loaves of bread, a Troy, N. Y., manufacturer has found a simple way of tieing wages to the cost of living.

C. W. Kelsey, as president of Rototiller, Inc., employs 120 men and women, most of them in manufacturing the rotary tillage type of farm and garden machinery. Recently, he told them that their wage and salary checks were being stabilized on the basis of bread at 16c per lb, the price at which it was being sold by most of the grocers in Troy. If the price of bread advances, so will the pay check, to keep its purchasing power at the same number of loaves of bread.

Here's a real "mechanic's garage"

radiant heating with National Steel Pipe assures warm floors . . . maximum comfort . . . at low cost



● The Kuykendall Chevrolet Company garage, in Lubbock, Texas, is skillfully designed with two important things in mind: High efficiency, for low operating cost; and maximum comfort, for higher worker output.

You can't beat radiant heating for attaining such results. It provides warm floors and uniform, comfortable temperatures throughout—ideal for garage work. Radiant heating eliminates above-floor heating units and makes the entire working area available. There are no obstructions, no hot spots, no cold areas or damp floors to handicap operations. These advantages have lead to the increasing use of radiant heating in modern garage construction.

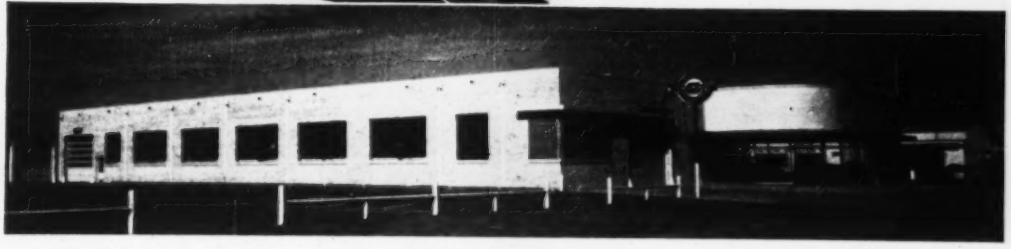
Steel pipe is unequalled for radiant heating installations. It's strong and ductile for easy bending. It's ideal for making welded joints. And steel pipe is so strong that it's hard to damage during installation. Best of all: it's durable in service and economical to use. When you buy National Steel Pipe, you're buying the same reliable steel pipe that has been the standard for conventional heating for more than sixty years.

If you are planning a radiant heating installation in a garage, store, terminal, factory, warehouse or plant, be sure to get all the advantages of using National—world's largest selling pipe.

Write today for our free 48-page book on Radiant Heating. It includes data for estimating heat losses, designing coil systems for floor and ceiling installations, typical coil patterns, testing procedures, fitting resistances, insulating techniques, pipe data and heat transmission tables. Ask for Bulletin No. 19. National Tube Company, Frick Building, Pittsburgh 19, Pa.

NATIONAL TUBE COMPANY, PITTSBURGH, PA.

COLUMBIA STEEL COMPANY, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

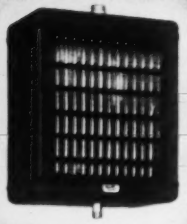


USS TRADE MARK

NATIONAL Steel PIPE

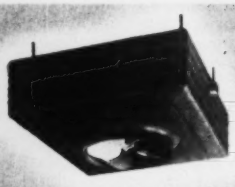
UNITED STATES STEEL

HEAT – as, when, and where you want it



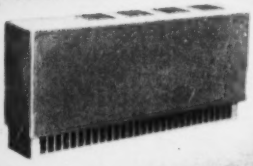
For Stores, Shops, Factories . . .
PROPELLER FAN UNIT HEATERS

Standard Webster-Nesbitt suspended unit heaters for quiet, economical working-zone comfort with easy controllability. Rugged, compact, efficient, incorporating standard or low-temperature non-ferrous heating elements of extended fin-and-tube type. Nine basic models in capacities from 34,700 to 338,000 B.t.u. Publication WN-126.



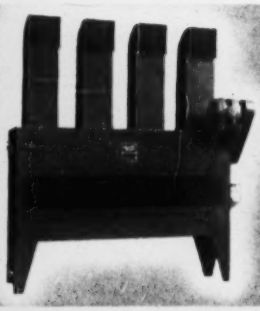
For Factories, Garages, Doorways . . .
LITTLE GIANT UNIT HEATERS

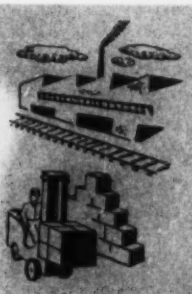
Downblow propeller fan units with blower fan performance, combining wide selectivity and versatility. Seven basic sizes: four larger draw-through models discharge a high-velocity vertical or horizontal downblow; three smaller blow-through models discharge vertically downward from lower mounting heights. Non-ferrous standard or low-temperature heating elements. Capacities from 23,900 to 348,000 B.t.u. Publication WN-134



For Vestibules, Lobbies, Corridors . . .
SERIES R UNIT HEATERS

Attractive, widely flexible cabinet units with low-speed belt-driven centrifugal fans and non-ferrous heating elements. May be installed as a vertical or horizontal floor, wall, or inverted-type unit, where appearance and concentrated heat are essential. Four unit sizes: 2, 3, 4 or 5 fans. Steam heating capacities from 158 to 588 e.d.r.; air deliveries, 518 to 1890 c.f.m. Publication WN-133.





For Factories, Warehouses, Hangers . . . GIANT UNIT HEATERS

Blower-type Giants for handling large quantities of air at relatively low final temperatures. Available in nine sizes for floor, wall, and ceiling mounting. Three types of control: Standard (motor control), Thermadjust (by-pass control), Valve Control. Capacities range from 2550 to 18,100 c.f.m. at final temperature, and 101,000 to 1,008,000 B.t.u. per hour. Publication WN-128.

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Made by **JOHN J. NESBITT, INC., PHILA. 36, PA.**
Sold by **WARREN WEBSTER & CO., CAMDEN, N. J.**

Webster Nesbitt
UNIT HEATERS

• DO YOU HAVE something you'd like to say about any of the articles published this month? An additional comment, or perhaps a question on some point? Or do you want to express your views on some matter of interest to heating, piping and air conditioning engineers or contractors? We follow here the practice at engineering society meetings of providing an "open for discussion" period toward the end of the session. You are invited to participate. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

GRAVITY AND VACUUM RETURN SYSTEMS

IN COMMENTING on material published recently regarding the operation of gravity return and vacuum return line heating systems, it is my opinion that any two pipe steam heating system with any type of radiation will operate more satisfactorily when a vacuum pump is used. The chief difference in the operation of a gravity return system and a vacuum return line system is that steam flow is much faster in the vacuum return system due to rapid removal of air from the return piping by the pump, whereas the air must be forced from the piping by the steam flow in the gravity return system.

Steam flow in a gravity return system having lifts in the return piping is further retarded by such lifts due to much slower discharge of air because of the air having to pass up through the lifts.

Two pipe gravity return systems should be designed and installed in keeping with good engineering and workmanship. Such systems may contain far more than 10,000 sq ft equivalent direct radiation. Steam distribution is much more satisfactory when orifices are installed in the radiator inlet valves or adjustable radiator valves are used. A vacuum return line system properly designed and installed will operate satisfactorily as a gravity return system when the vacuum pump is inoperative, although steam circulation will be much slower.

The chief requirements in the design and installation of a gravity return system are that the steam and return piping be sized as recommended in pipe sizing tables for systems of this type and that there definitely be no lifts in the return piping. It is necessary that such installations be entirely free of lifts in the return piping so there will be free venting of air to provide minimum resistance to steam flow into the system.

Installations such as described could be improved by installation of condensation pumps at the points where the lifts are now installed in the return piping. The installation of these pumps should be such that condensate would flow by gravity into them and the pumps in turn would discharge to the vacuum return piping at a higher level. In this manner, the return piping will be kept free at all times and more satisfactory heating results will be obtained.

Vacuum pumps used in systems having lifts in return piping should run constantly. When the pump runs constantly the return piping will not fill with condensate at low points and air will be removed much faster.

It should not be difficult to maintain radiator valves due to use of a vacuum pump on such a system, inasmuch as there will most likely be steam at pressures above atmosphere most of the time at the radiator valves. Exceptions to this would be at such times as the control valves of the zones would shut off and at such times a vacuum may exist in the radiation due to condensation of steam in the radiation. However, on the standard vacuum return line system, this vacuum would likely be less than 10 in. maximum which should not prove to be troublesome. Also, present radiator valves could be replaced with packless valves, requiring no maintenance, if desired. — J. W. JUNGELS, C. A. Dunham Co.

WITH REGARD TO Mr. Jungels' remarks, while I fully agree in principle with most of his comments, perhaps it would be well to point out that while a vacuum pump will perhaps make any two pipe heating system work more satisfactorily, it is entirely possible that the system might work so well without the pump that the additional satisfaction derived from the use of a pump may not justify the cost of the pump and the added cost of operation and maintenance. There definitely is a "point of diminishing returns" in a heating system.

Also, it should be pointed out that when a vacuum pump is used, steam flow is faster not because the air is removed from the system more rapidly but because there is a greater pressure differential between the steam main and the return system. The air is removed more rapidly just the same as the steam travels faster and for exactly the same reason. This cause and effect relationship, while quite obvious, should not be confused as it sometimes is.

As a matter of fact, in the operation of a heating system, air is objectionable only when it takes space that should be occupied by steam or condensate, or when it causes a back pressure that reduces or eliminates a pressure differential in the system. All we have to do to prevent trouble

because of air in the system is to eliminate the air, and there are many, many ways of venting air. Once the system has been purged of air, the vacuum that will occur from the change in volume of steam as it condenses to water will be just as effective as the same magnitude of vacuum created by a pump. This is especially noticeable where there are control valves in the steam supply.

Recently, the matter of being able to lift water in returns, and the use of lifts in the return piping of heating systems, has come in for considerable discussion. We all know of installations where lifts have caused trouble and we all know that no conscientious engineer would go out of his way to find places to use lifts. But other conditions in heating systems also cause trouble and lifts are sometimes blamed when they are actually not at fault. It does not seem wise to condemn all lifts in vacuum return systems because we know that some have not worked. There are numerous conditions in a heating system that will cause a lift to appear to fail, and in many cases the remedy is much more simple than added equipment or extensive piping changes.

A vacuum or gravity return system is flexible, and if properly vented, so long as there is differential pressure enough, either from the steam or from the weight of the water itself to overcome the resisting influences, the condensate will return without difficulty even though at some place along the line it may have to go up hill. A case in point is a system in which the returns are at all times completely filled with condensate.

If handled properly, orifice plates in the radiator inlet valves, or adjustable inlet valves, are valuable in obtaining proper room to room steam distribution and reach their full effectiveness when used in conjunction with an adequate control system.

The suggestion of running a vacuum pump constantly when lifts are present in the return line, is a general statement that might prove disastrous if applied indiscriminately to all heating systems having lifts. All that is necessary to make a lift work is a sufficient difference in pressure between the inlet and outlet of the lift to elevate the weight of the water through the distance of lift and to overcome the resisting factors. If vacuum is required on the discharge side of the lift, then all that is essential is that the amount of vacuum required be present during the time the return is in operation. On a tight system in very mild weather the quantity of condensate handled by the pump might well be so small that if the pump is set for continuous operation, overheating of the pump with ultimate mechanical damage may be expected. If the pump is allowed to operate automatically to maintain a vacuum sufficiently high to make the lift work, no damage to the equipment will occur.—DELMAN E. SCHROEDER, construction inspector, Iowa State College.

"QUOTE"

AIR CONDITIONING, is the engineer's gift to the owners of old buildings — particularly old office buildings.

Most old office buildings were built to fill the lot and have a high percentage of deep space, despite the fact that the deep space has brought very little rent.

Air conditioning has radically changed these deep space economics. In one case, air conditioning enabled a building to convert its basement into offices to rent at $5 a ft. In another case, air conditioning enabled a one-time loft building to modernize to compete for high grade tenants with post-war buildings. ARCHITECTURAL FORUM: THE MAGAZINE OF BUILDING, in a recent article.

SIZING PIPING FOR ANTIFREEZE SOLUTIONS

I HAVE READ with very great interest the article How to Size Piping for Antifreeze Solutions, published as the Data Sheet in the November HPAC, and I am sure it will interest many readers.

I note the authors have followed the formulas which many have recognized as standard, and in practice are found to be quite as close to the actual result as that determined for the flow of water in pipes. Many of the modern handbooks describe the effect of viscosity on flow as some function of the viscosity raised to the X power. This formula assumes the form $P = K \times V^x$, where P is the head in ft drop, K is a constant and V is the kinematic viscosity in centipoises. The exponent X, according to modern engineering books, varies from 0.2 to 0.5.

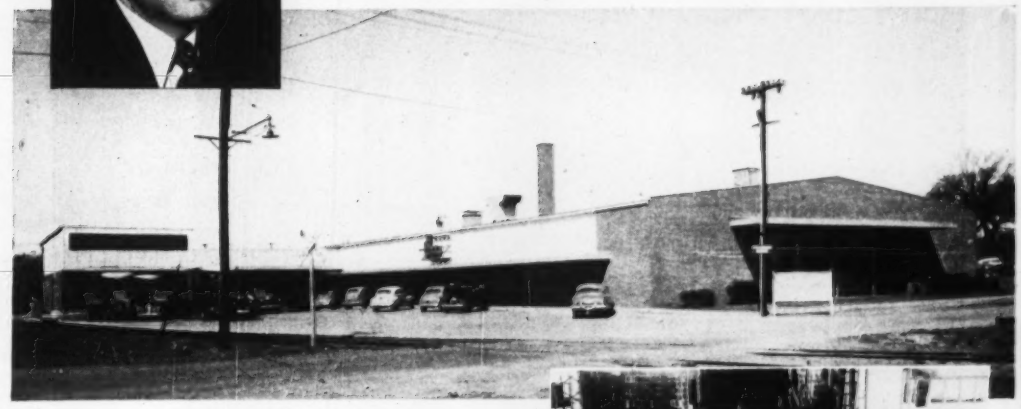
I have found in my work that using the value for $X = 0.25$ gives quite reliable results. The authors, on the other hand, have chosen 0.2. This slight variation affects the final answer by approximately 5 or 6 percent only, which seems to be well within the limits of the accuracy with which the head for water can be calculated, and, therefore, can be considered as quite satisfactory.

Since the viscosity varies greatly with changes in temperature of the solution, much liberty is allowed the engineer when designing the system. I notice further that the authors express the kinematic viscosity as lb sec/ft.^{2} Usually, the viscosity is denominated centipoise and most of the available tables express the viscosity in this unit. It may be that the authors did not wish to confuse the average reader, and expressed viscosity in English units. This is of no particular significance, except for the fact that the reader may decide to use the formula when calculating the head for other solutions for which he knows the viscosity in centipoises. It seems to me that it may be desirable to add a note to the article explaining that the formula will hold equally as well for the viscosity expressed in English units as well as in the centipoise units.

The article is one which I believe will stimulate a lot of interest because the information available is rather scarce and many people are confused on this subject. The article simplifies the rather complicated equations and should be of great help to many.

I commend HPAC for publishing material of this nature.—T. NAPIER ADLAM, vice president, Sarco Mfg. Corp.

REVERE DISTRIBUTOR *Takes his own Advice*



...Harry Cooper Supply Co. installs 16,700 feet of Revere Seamless Copper Water Tube for Radiant Panel Heating in its New Office and Showrooms.

For over 15 years Jack Cooper, President of the Harry Cooper Supply Company, Springfield, Mo., has been advising his customers to use Revere Copper Water Tube and other Revere products. He has learned from the many contractors he has sold how it performs . . . its fine record of service. So when he was planning the heating system for his new office and showrooms he picked Revere Copper Water Tube to do the job.

Those who have used Revere Copper Water Tube will tell you that the long lengths of Revere Copper Water Tube make it a real time saver on any radiant panel heating job and that fewer tools are needed to form radiant panel heating coils. Long lengths also mean fewer joints, while light weight simplifies handling. Revere Copper Water Tube cannot rust or rot and has high resistance to corrosion. This means long life. Joints are quickly and easily made with solder fittings, keeping installation costs surprisingly low.

All Revere Copper Water Tube is stamped at regular intervals with the Revere name and the type. Look for these marks, for they are more than identification, they are your assurance of full wall thickness and the close dimensional tolerances so essential for tight soldered joints.

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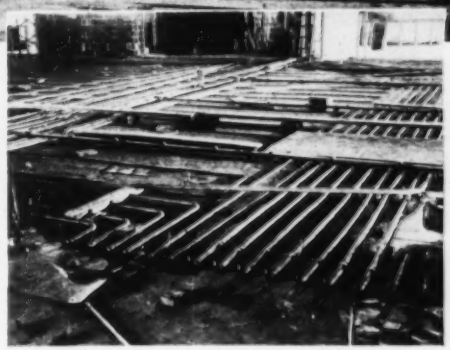
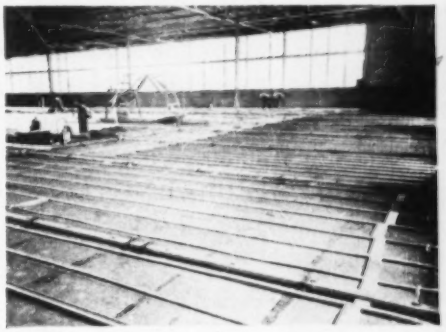
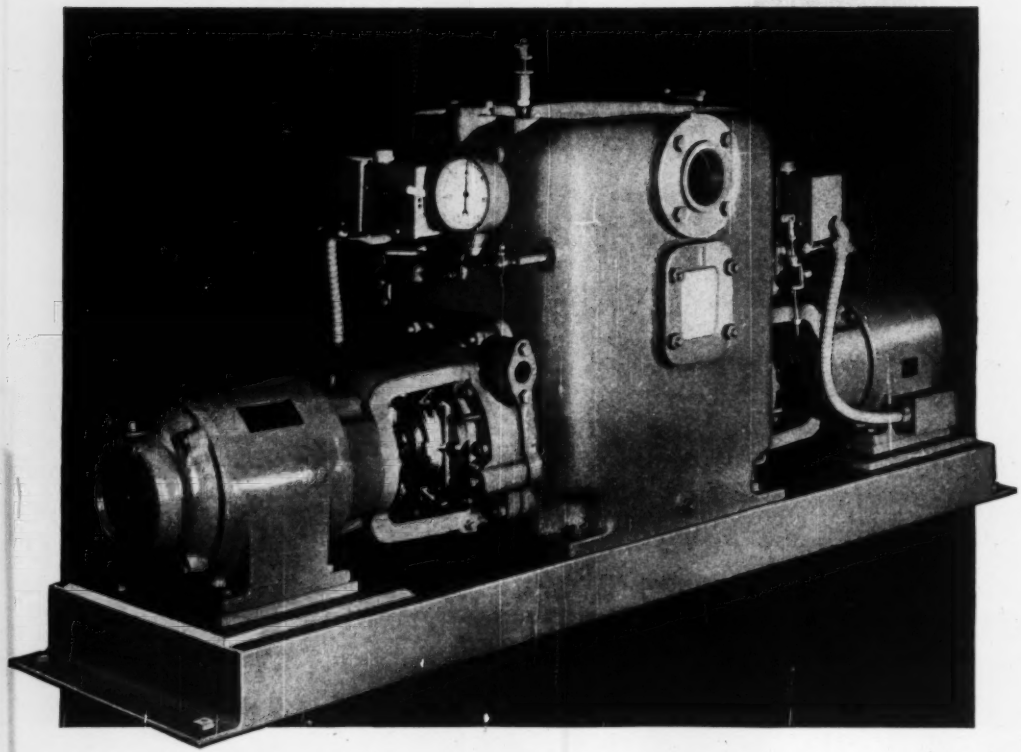


OVER 3 MILES of Revere Seamless Copper Water Tube was used in the radiant panel heating system recently installed in the new office and showrooms of The Harry Cooper Supply Co., Springfield, Mo. Sizes ranged from ¾" to 2".



EVEN, RELIABLE HEAT is assured in all parts of this office by these radiant panel heating coils which were set in a concrete floor slab. Made of Revere Copper Water Tube, coils were easy to bend, needed few fittings, were light to handle. Area of floor panels measures 17,000 sq. ft. Architects, Hawkins & Esterly; Genl. Cont., Chapman & Bramer; Heat. Cont., Bowman & Drussa Plumbing & Heating Co.; Plumbing Cont., Central Plumbing & Heating Co., all of Springfield, Mo.



THE HEATING PUMP WITH CERTIFIED PERFORMANCE

A Jennings Return Line Vacuum Heating Pump may be installed with the absolute assurance that it is of the proper capacity to keep your heating system at top-notch efficiency.

For the actual working capacity of your Jennings Pump is determined by careful tests under working conditions, and with the actual motor that goes on your job, regardless of current characteristics. Every Jennings Pump has to deliver full rated capacity of air and water simultaneously before it is released.

The Jennings Heating Pump has everything in the way of safety, convenience, and real dollar saving economy that years of experience as leading heating pump manufacturers have enabled us to put into it. Quality is backed by an unchallenged reputation, and satisfactory performance is assured by a nation-wide network of Sales and Service offices.

THE NASH ENGINEERING COMPANY

Control Pump from Water Level To Improve Boiler Operation

John W. James, chief research engineer, McDonnell & Miller, Inc., points out that refinements available in the operation of water line controls make it both possible and practical to maintain boiler water levels automatically within prescribed limits by controlling pump operation in response to small variations in water level. Along with the high overall operating efficiency obtained through uniform water level is the very important safety of a control of this type, which provides protection from low water

OVERALL BOILER plant operating performance and efficiency can be materially improved by the automatic control of a uniform water level. While achievement of this objective was once confined to large power plant equipment, simple yet reliable controls are available to accomplish it on low, medium and high pressure boiler plants for heating and process steam.

Whether the system is designed for heating or process work, whether single or multiple boiler installations are involved, whether condensation pumps or vacuum heating pumps are utilized, the basic control for maintaining a uniform water line involves a float operated device positioned so the boiler water level may be accurately reproduced similar to that shown in Fig. 1.

In one type of these controls, variations in water line are transmitted through a float arm to a set of electrical switches. One of these switches is arranged to control the boiler feed pump operation in response to small variations in water line. Generally, an additional low water fuel cutoff switch is provided which may be wired to interrupt the electrical circuit to a burner in case an emergency of any sort should cause the boiler water to drop into the danger zone. Also, a control arrangement is frequently provided in a control of this type to sound an alarm or turn on a warning light.

In many of these systems, it is customary to merely employ a float operated switch on the receiving tank which functions to start and stop the pump depending upon condensate

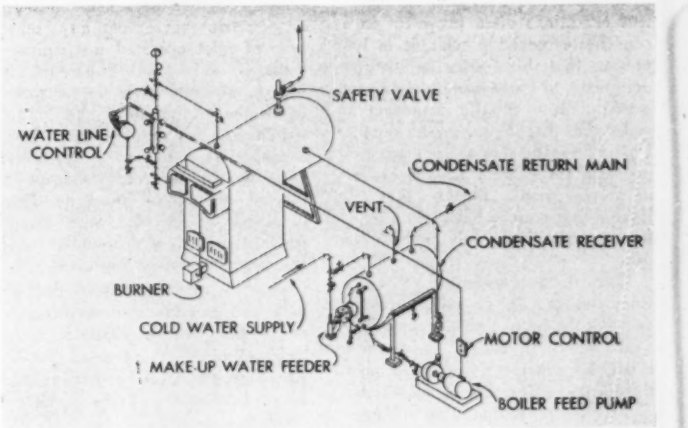


FIG. 1—BASIC CONTROL for a uniform water line involves a float operated device positioned so boiler water level may be accurately reproduced

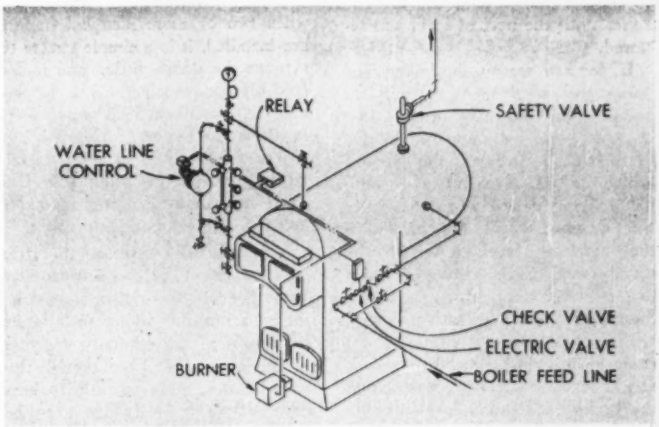


FIG. 2—NO BOILER FEED PUMP is used on this installation, but a switch operates an electric valve to feed water to the boiler

accumulation in the tank. It is readily recognized that this method of control assures the eventual return of condensate to the boiler, but it is probable that the boiler will often be operating under flooded conditions or else lack sufficient water to maintain proper load demands.

In addition to the boiler water line control shown in Fig. 1, it is customary to install a float operated feeder on the tank to provide an adequate supply of water for pump operation in case there is any delay in return of condensate. This make-up feeder is quite simple in design in that it merely opens an inlet valve from any available water supply, allowing water to be admitted until the float rises sufficiently high to close the valve. Due to the turbulent conditions often prevalent in a condensate receiving tank, it is important that this feeder be sturdily designed to withstand abnormal stresses. It is equally important to make sure that the feeder has ample capacity to take care of sudden boiler demands for either a heating system or process plant. Further, it is advisable that it be mounted in a position to maintain a minimum water line.

With this arrangement of water line control, it is customary to position the control so that the boiler feed pump operation is stopped when the water level is at or near the normal water line in the boiler — frequently, midpoint in the gage glass. Then, if the water level should drop, say $\frac{3}{4}$ in., the electrical contact would be closed to the pump circuit and water would be fed to the boiler until the normal level was restored.

If, for any reason, the boiler feed pump had insufficient capacity to balance an unusual water loss or was rendered inoperative due to electrical failure, the second switch would turn off the automatic firing device when the water line dropped about $1\frac{1}{2}$ in. below the normal level. When the water was again brought back to a level of $\frac{3}{4}$ in. above the cutoff point, the burner would be restored to operation. By comparison with the above switch operations, it will be realized that the boiler feed pump is continuing to operate while the burner is off and will continue to function until the water level reaches a point $\frac{3}{4}$ in. above the "burner on" position. During any one of these cycles of operation, the make-up feeder stands guard to insure a minimum water level in the receiving tank.

On some high pressure boiler installations, where the available water pressure exceeds the maximum operating steam pressure, it is possible that the boiler feed pump may be omitted. On these systems, the condensate is generally returned by gravity due to differential pressures available between the supply and return.

Here again, a water line control can be used to advantage. In this instance the switch, arranged to operate the pump as previously described, is used to open and close an electric valve or any other type of pilot operated mechanically actuated valve as illustrated in Fig. 2. As the boiler water drops below the normal level, the control switch opens the electric valve, allowing water to feed to the boiler until the proper level is restored. Special precautions must be taken to select an electric valve design which will safely withstand the steam and water operating pressures.

The use of this control arrangement will, in addition to assuring the maintenance of a uniform water level, eliminate the necessity of an attendant to check constantly the water line and add the necessary make-up.

Multiple Boiler Installations

The opinion seems to prevail that when two or more identical boilers are installed, it is a simple matter to arrange the steam piping and boiler feed piping in such a way as to permit the equalization of water level in all of the boilers. Although this objective is realized in a few installations, it is more often true that some remedial measure must be taken to correct faulty operation.

It is generally assumed that free communication exists between the steam headers and return water piping in a multiple boiler installation by reason of the specially designed equalizing pipes. Even though this may be true, it is possible to have different water levels due to small pressure differentials. Pressure variations are due, principally, to differences in steaming rates caused by the inability of a firing device to be adjusted to produce an equal output in two or more boilers. This unevenness in firing rate would be normally expected with hand firing, but it is a situation that commonly prevails even with automatic firing due to the difficulty of accurately adjusting fuel input.

Sometimes the need for additional load capacity requires that the added boiler be installed at a different level. Some designers have attempted to feed both boilers from the same return system and still maintain a normal water line in each boiler by the use of specially designed equalizing lines. None of these arrangements has proved universally satisfactory.

Some designers have attempted to maintain uniform water level in two boilers of unequal size or capacity by elevating the bases to position the normal water line in each boiler at the same level. Despite this precaution, and again utilizing what are considered acceptable equalizing arrangements, wide fluctuations in the desired water level generally result.

Another troublesome situation in the maintenance of uniform water levels occurs when two or more boilers of the flash type or small water content design are connected together. Difficulty is apt to occur when these boilers are forced, and water is thrown out into the steam piping — resulting in very uneven water lines in each boiler.

These problems of water line variation in multiple boiler installations can be overcome by the selection of a control arrangement similar to that shown in Fig. 3. It will be noted from this drawing that boiler water level controllers are installed on each boiler in such a position as to maintain the desired water level. In addition, electric operated valves are installed on the feed line to each boiler.

The wiring is arranged so that when the pump switch is closed in any one of the water level controls, the boiler feed pump operates to take care of the required demands. At the same time the electrical circuit to the pump is closed, the respective electric valve on the boiler needing water is opened, allowing make-up water to be fed until the normal water line is restored. At this point, the water

level control stops the pump and the electric valve closes. As with the systems previously described, it is common to install a make-up feed on the receiver to insure minimum water supply for the pump at all times, in the event the condensate is retarded from returning to the tank.

It will be recognized that with this arrangement, even though a single boiler feed pump unit is utilized, water can only be fed to a boiler where the electric valve is open. With boiler water level controlled in this manner, it becomes obvious that it makes little difference how the equalizing lines are connected, the size of the boilers installed, or the relative positions of the normal water lines, as with this arrangement the water line in each boiler is individually controlled.

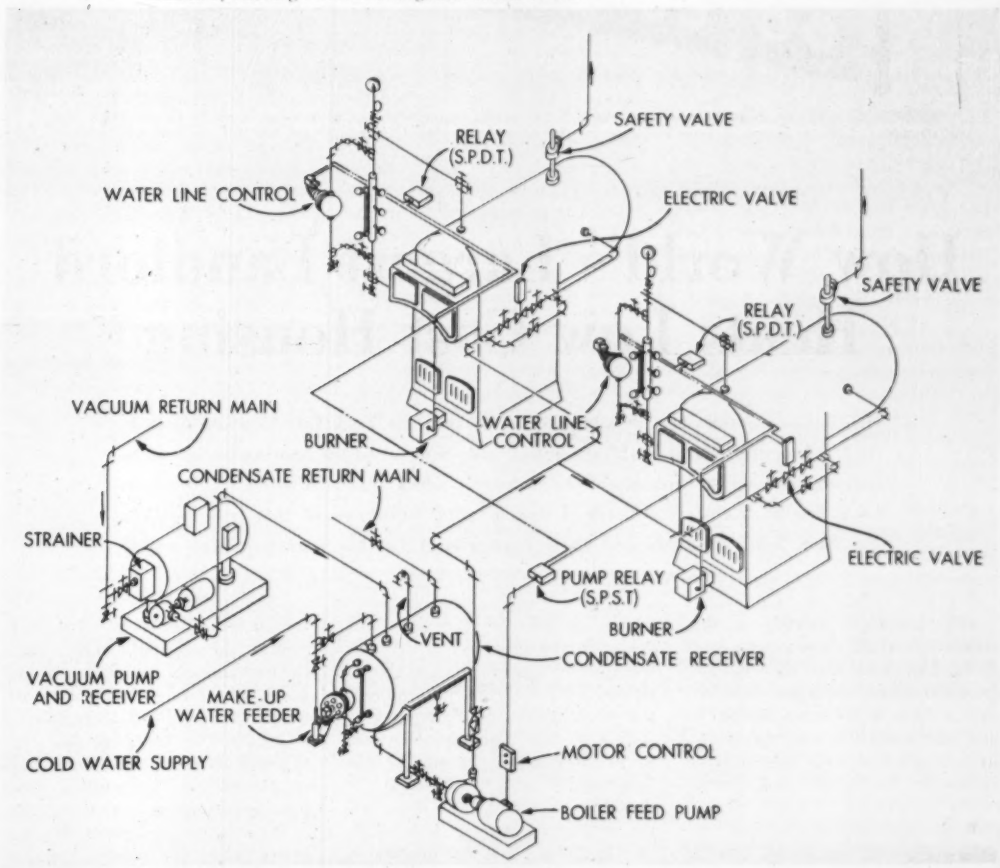
In place of the electric valve, it is possible to use a float operated throttling feeder which will meter feedwater to the boiler and similarly obtain individual boiler control with a single pump.

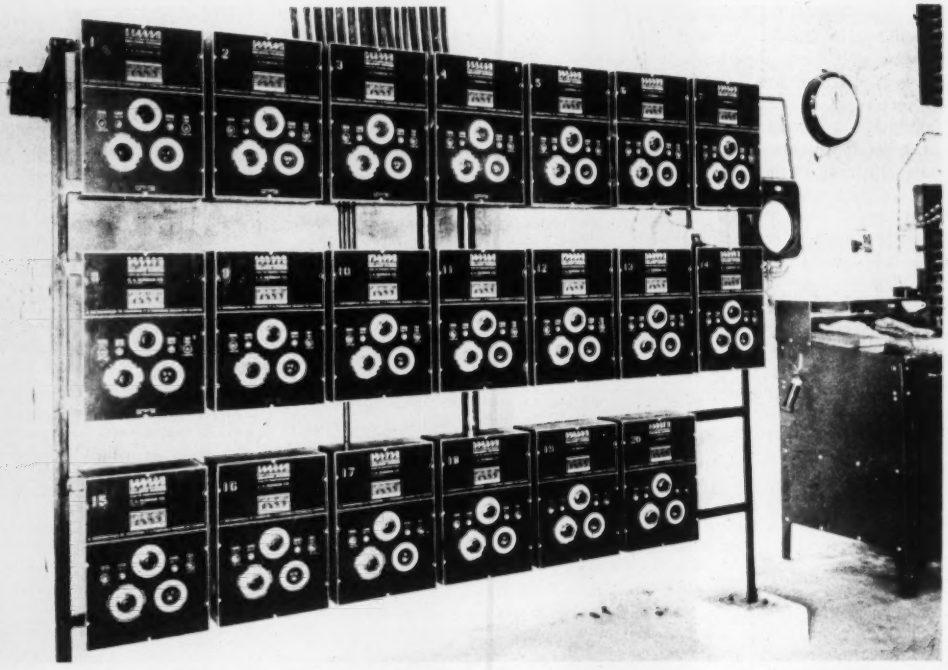
The return of process or heating system condensate to a boiler through a vented receiver and feed pump presents no special consideration. However, the introduction of a vacuum pump on the condensate lines presents a situation which requires auxiliary equipment when it is desired to control closely the boiler water line through feed pump operation.

The principle of vacuum pump operation varies depending on the design of the unit, but regardless of the sequence of operation, it is recognized that the pump will function in response to either water level or vacuum. Whenever the pump operates according to water level, it is functioning as a combination pump and receiver unit. However, the maintenance of an established vacuum on the return piping of a system requires that the pump operate at intervals which are frequently not coincidental with water accumulation in the receiver.

Because of these complications in vacuum pump control and operation, it has been found desirable to discharge the water from one or more vacuum pump units to a separate receiver or accumulating tank, as illustrated in Fig. 3. Then, with an additional feed pump unit pulling condensate from this tank and returning water to the boiler in response to water line control, a very satisfactory installation results. Of course, it is customary to install a make-up feed on the accumulator tank to take care of any deficiency in condensate return.

FIG. 3—MULTIPLE BOILER installations have water line variation problems which can be handled by selecting a control arrangement similar to this





CONTROL BOARD for heating system in central boiler plant serving a project comprising 20 six story buildings, 1188 apartments. Control valve in each building can be opened or closed, manually set, or put on automatic control

How World's Largest Landlord Heats Low Cost Housing

Heating procedures and details adopted by the New York City Housing Authority for its hundreds of buildings are of wide interest to the heating trade and to housing authorities throughout the country. Lewis Smith (of the C. A. Dunham Co.) has been closely concerned with heating buildings of this type, reviews the New York methods and their background in this very practical article

CONTROLLING THE heating of the extensive low cost housing projects of the New York City Housing Authority is a most important consideration. Even a moderate saving in fuel runs into big money, due to the large number of both projects and buildings. The control should be as nearly 100 percent automatic as possible, without too many "gadgets" to get out of order, and should be centralized to save labor required for operation and supervision.

Approved control systems are restricted by the Authority to those of the "continuous flow" type. The Authority has elaborated on the word "continuous" by stating that "the control valve shall be of the throttling continuous flow type and the contractor's attention is called to the fact that it must operate to throttle steam supply at up to 15 lb pressure above atmosphere without closing, under all conditions of outdoor temperature below approximately 65 F, and that no completely intermittent or pulsating flow type of control valve and steam flow equipment are permissible under these specifications."

Three types of systems are permitted under the present specifica-

tions. In abbreviated language, they are;

1) A system capable of controlling the pressure differential between the supply and return mains so as to fractionally heat the radiators to meet the heat loss demand.

2) A system capable of circulating steam at variable subatmospheric pressures and temperatures.

3) A system capable of controlling the supply pressure, with atmospheric returns, so as to fractionally heat the radiators to meet the heat loss demand, with continuous steam flow until the heat demand has fallen to 35 to 40 percent of maximum demand, beyond which point "time modulation" of the control may be used. This has the effect of permitting intermittent steam flow in mild weather.

To date, about 70 percent of the projects have used scheme (2). An advantage of this method is that it provides good control of the exposed piping and heat risers up to the maximum vacuum at which the systems will circulate, which is usually around 25 in.

This is an important point when it is realized that the combined heating effect of all this exposed piping is usually over 30 percent of the total heat loss and is figured as part of the installed heating surface. If uncontrolled — or only partially controlled — this heating surface may overheat the rooms in mild weather, causing uncomfortable conditions and fuel waste.

Preventing Tampering With Orifices

Control systems require some form of restriction at the radiator inlet valve. Until recently, this was done at the New York City Housing Authority projects by the use of orifice plates but these brought to light a rather unusual problem which is largely associated with the use of radiators and exposed piping.

It is essential, especially with straight orifice systems, that these plates not be touched by other than authorized persons. However, in these low rent projects, individual preferences as to the amount of heat cannot be catered to. The attempt is made to provide an average of 70 to 72 deg in all rooms at all times when heat is on. This means, of course, that at times some rooms may be a degree or two lower than 70. Many tenants have come from quarters that were habitually overheated, or where an excess of heat was available if wanted. Some tenants object to the idea of mass control and their inability to get extra heat whenever they want it.

For whatever reason, some tenants had discovered that by breaking open the valve unions and removing the plates, they could get more heat. Where these plates were essential to control, the removal of the plate meant the complete loss of control on that radiator.

To correct this situation, the Authority specified that orifice plates must be secured to the end of the spud or tail piece of the valve union, thereby making it extremely difficult to get the plate out. However, it was also difficult to change plates when balancing the systems and it is certain that some changing has to be done not only to get the original balance but to correct local inaccuracies after a project is occupied and run. At least one manufacturer is providing a radiator valve for these projects with an adjustable orifice fitting incorporated in it and accessible only by means of a special wrench. This valve facilitates the original balancing, as well as later changes by the operating staff when necessary.

Centralized Control Saves Fuel, Labor

The first few New York projects had group boiler plants, each serving several adjacent buildings, and the heating system control panels were put in those boiler rooms. It was later found to be more economical to use central plants for an entire project. After balancing the first cost of the extensive underground wiring against the saving in labor of operation and the fuel saving resulting from close supervision, it was decided to put all the control panels for the heating systems in the central plants. This calls for periodic inspection of the performance of the controls in each building, or the provision of means in the panels at the central plant to enable the operator there to see what is going on. To avoid the expense of having men visiting the many buildings, the Authority specifies that each panel must have means to show the valve opening, to set the valve manually at any desired opening or percent of heat and to read the percentage of heat or the steam pressure in each of the buildings.

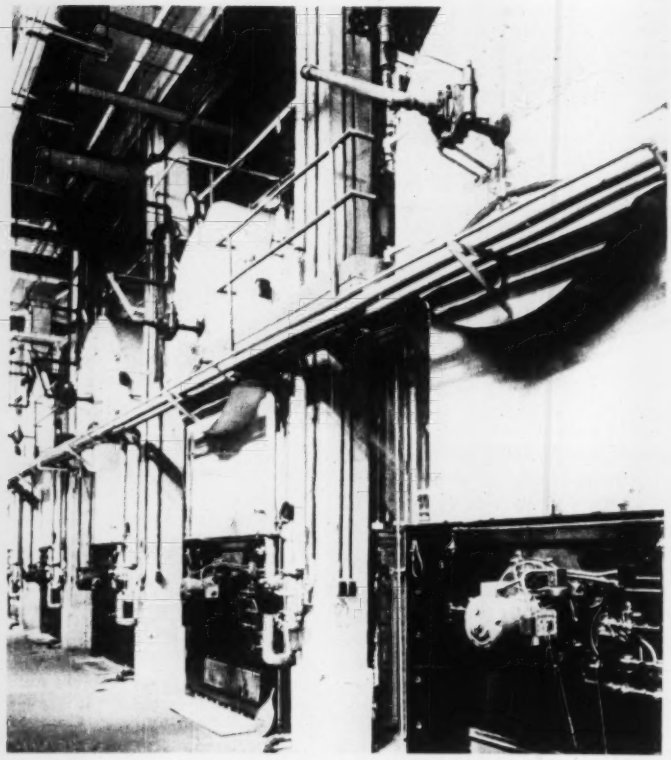
If the control panels had been left in the buildings, it would have been necessary either to have several men on hand early in the morning to turn the heat on (and late at night to turn it off), necessitating two additional shifts with relief men, or to use time clocks. Added to the men required for checking during the day, this would have meant quite an army.

If time clocks were used, these would have to be set seasonally for the longest heating-up time and the latest shutoff time for the coldest weather expected. It would also be a practical impossibility to take advantage of late start and early shutoff on the milder days. Thus the fuel cost would go up.

How Vacuum Pumps Are Controlled

If vacuum pumps are used, the Authority calls for immersion type switches in the steam main in each building not less than 50 ft beyond the control valve, arranged to switch the pumps automatically to float control when steam is shut off by the closing of the control valve, and to vacuum control when the steam is turned on. These are set 50 ft beyond the valve to guard against leakage which may take place through double seated valves.

With all these requirements met, the central station operator can open each control valve separately to whatever extent is necessary to circulate steam with reasonable speed and at the latest possible time in conformance with the outside temperature. He can do this as rapidly or slowly as he pleases to control the boiler load and to avoid starting up cold boilers needlessly. He can hold the valves at a fixed position for heating-up and put them on automatic control when he pleases, thus being able to adjust the length of the heating-up period to suit the outdoor temperature. Thereafter, during the day, he can see by the indications on the panels what is going on in each building and at night he can shut down again at an hour determined by the outside temperature. Meantime, the vacuum pumps take care of



FIVE BOILERS serve the same project of 1188 apartments. Of the high fire box, steel, fire tube type, they are each rated at 42,500 sq ft EDR. It is the Authority's policy to use boilers that can be factory assembled

themselves with the switches previously mentioned.

All told, a large saving is being made in both fuel and labor costs by this scheme. It is estimated that the extra cost of all the wiring will be amortized out of this saving in a short time.

Coordinating the Control and the System

One of the things which gives the Authority concern is to make sure that it receives a control system in which all the parts have not only been coordinated by responsible people but one in which these parts will work in harmony with each other.

The specifications therefore state that "the radiator valves and orifices and all radiator and drip traps shall be furnished by the manufacturer who furnishes the heating controls; or if not, in addition to complying with these specifications, they shall be acceptable to the control manufacturer, and the contractor shall assume the responsibility for their operation in connection with his control system." It is also stated that "all vacuum and condensate pumps shall be of a suitable type, operating characteristics and capacities for the heating control system selected." Elsewhere it is stated that "all parts of the control system, including control valves, shall be of a type designed for use with the hereinbefore described system (of heat control), and shall not be assemblies of parts not designed for this specific use." The following statement is also included:

"Before final approval of the controlled heating system, it must be demonstrated by the contractor by tests made in the presence of the Authority that steam circulates quietly and in uniform proportion to each radiator in each building under all positions of the control valves, when operating under control of the automatic control device for each building. The contractor shall then furnish to the Authority an affidavit from the manufacturer of the control equipment that each completed controlled heating system installation and its operation have been coordinated by him to function properly as a unit, all in accordance with the drawings and specifications. The controlled heating systems shall be capable of varying the steam supply to all heating units for changes in demand resulting from changes in the outdoor temperature so as to prevent overheating and underheating and effect maximum economy in the utilization of steam for heating."

Finally, under the heading of "Tests", the following is included:

"The contractor shall run a test of the controlled heating system in each building and shall demonstrate to the satisfaction of the Authority that the requirements specified (as outlined above) have been met. In addition to other requirements, at least six simultaneous temperature readings shall be taken in each building with recording thermometers for a period of 24 hr."

Inside Temperatures Not Stated in Specifications

It is to be noted that no specific temperature variations are stated. Instead, "satisfaction of the Authority" is the requirement to be met. In fact, the inside temperature is not stated in the specifications nor is the contractor required to guarantee any specific inside temperature. However, on the heating schedules made up for each job it is noted that the inside design temperature is 70 F for all heated spaces except 60 in the laundry and shops.

One reason for the lack of exact definition of "over heating" and "under heating" is that there has been so much pressure for living space that tenants have been moved in before the control systems could be completed and adjusted. No time is thus permitted for prior tests and this is especially true for space ready for occupancy at the end of a heating season when tests cannot be run on account of high outdoor temperatures and have to be deferred to the following winter. Thus, the temperature readings have almost always been taken in occupied apartments and are subject to all the fluctuations of open windows, tenant habits, etc.

It has been found, however, that these variations can fairly well be noted and discounted on the charts and on the whole a satisfactory picture of performance and adjustment of controls obtained.

When a whole building or a wing or floor has been out of line, approval has been refused and final payment witheld until the contractor has made suitable corrections. In the case of one job, several buildings were completed but could not be occupied due to a delay in sewer connections. Here the Authority was able to run temperature tests in unoccupied buildings and the results were found to be very satisfactory. Even so, the Authority finds it necessary to make corrections by changing orifice plates or the adjustment of valve settings after projects have been accepted and occupied.

Traps Discharge Through Condensate Coolers

All drip traps draining 10 lb lines and water heaters in the buildings are connected to the heating system returns. Where elevations permit, these traps discharge through the condensate cooling coil in the water heater. Where elevations prevent this, a cooling leg is provided of sufficient length to condense the re-evaporated steam flashed off from the hot condensate. Where space is limited, these cooling legs are made up in part of finned pipe.

Heating Design by Consulting Engineers

All heating system design is done by consulting engineers and only one requirement is made — that the radiation in apartments be designed to heat from zero to 70 with steam at 1 lb pressure. All factors used to accomplish this are left up to the engineers. Since the building design (both construction and layout) is pretty well standardized and has been used for a number of years, the Authority engineers know from experience almost exactly how much radiation is needed and thus they have a close check on the calculations. All steam piping exposed in rooms is figured to be part of the heating surface at 300 Btu per sq ft of actual pipe surface and is deducted from the calculated room heat loss before sizing radiation.

Generally speaking, exposure factors are not used unless there is an abnormal condition. Reliance is placed instead on balancing by means of the orifice plates or valves. As a result of this, and the standardization of layouts, one riser diagram for perhaps one-fourth of one building may serve for an entire project regardless of size. This saves cost in design and greatly simplifies the contractor's work in ordering and installing radiation.

Underground Piping for Steam Distribution

Piping is sized on an initial pressure of 10 lb and a maximum drop of 7 lb to the most remote building.

Originally, when group plants were used, "walk through" tunnels were built but as projects grew in size and central plants became standard, these tunnels proved too expensive and conduits of vitrified sectional tile or of several patented types are now used.

All underground piping is tested with 100 lb air pressure. Piping in buildings is tested for 8 hr with water at a pressure of not less than 25 lb at the top of the building, and after completion is given a vacuum tightness test.

Boilers Are Factory-Assembled

The boilers are of fire tube design, two pass, for burning No. 6 (bunker C) oil. They are tested to 60 lb and are designed for 15 lb operating pressure. Efficiency of 75 percent at 100 percent rating is called for.

One feature which is peculiar perhaps to the Authority is that boilers which can be factory assembled and shipped in one piece are used throughout. This may lead to what at first glance looks like too many boilers in some of the larger projects, but it has been found that final erected costs are lower when the sizes can be kept within those limits. Field assembly of boilers is thus eliminated.

The Authority has determined what instruments are needed for good operation in the hands of fireroom men, and has tried to avoid the fault of "over instrumentation" which is sometimes noted in large boiler plants elsewhere. Too frequently, elaborate instruments are neither properly maintained nor used and are allowed to fall into dis-use, due in good part to the lack of expert supervision by men especially trained for this service.

[Mr. Smith's article in the November HPAC described the background of the New York City Housing Authority, how heating equipment is selected, why steam is the heating medium chosen, the type of heating surface used, and how piping is run and piping expansion handled.]

CABINET UNITS INVERTED TO HEAT NAVE OF CHURCH

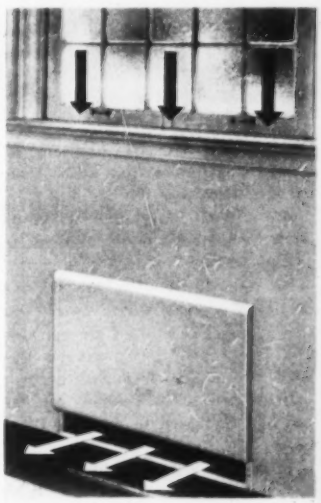
CABINET HEATING units recessed in the wall below the windows in an inverted position are used to heat the nave of beautiful St. Dominic's church in Shaker Heights, Ohio, a suburb of Cleveland.

Cold Air Drawn From Windows

Cold air is drawn from the windows into the units through grilles in the window sills, and heated air is discharged into the room through grilles at the floor line. Provision is made for taking in outside air through the units for ventilation during the summer.

William Koehl was the architect, and Cutting & Ceresi the engineers. The heating and ventilation equipment was installed by James F. Walsh. [Photo courtesy Modine Mfg. Co.]

INVERTED CABINET units take air through window sill, discharge heated air to room at floor line



COLUMBUS HOSPITAL addition piping system includes oxygen, nitrous oxide, helium, carbon dioxide, air pressure, vacuum, and spare pipe line

Central Oxygen, Anesthetic Piping Important Services in Hospitals

Central piping systems for oxygen and anesthetic gases offer many advantages to hospitals, savings in labor alone sometimes halving the expense of supplying gas to individual cases. In new construction, installation costs may run $60 to $70 per outlet, or only $2.50 per outlet per year over the hospital's life. The piping at the new Columbus hospital addition, Chicago, one of the most extensive to date, is described here

OXYGEN AND ANESTHETIC piping in hospitals has grown from a few isolated installations in the late 20's until practically all hospital plans drawn today include such piping systems, as well as vacuum piping.

As recently as 1936, oxygen was employed only as "a last resort" and the average case used oxygen for 1-1/2 days. By 1943, oxygen was used as a matter of course whenever patients needed its benefits, and its use had increased to 4-1/2 days per case.

In the early days of oxygen therapy, a strange belief seemed to exist concerning oxygen for hospitals. Anesthetists and doctors had been using oxygen from small medical cylinders and some of them objected to using "welding" oxygen for humans.

Albert E. McKee, president of the Oxygen Equipment and Service Co., Chicago, who began installing oxygen piping systems on a full-time basis in 1936, investigated this belief. He found that suppliers of oxygen often filled small, medical cylinders with oxygen from the large industrial cylinders to which the profession objected. Upon further investigation, he learned that oxygen for use in hospitals doesn't need to be even near 100 percent pure. The reason is that people breathe a mixture of gases in the air with no ill effects. However, oxygen for welding must be close to 98 percent pure or the flame will be affected. Thus, hospitals were paying extra for the filling of medical cylinders and getting the same oxygen as used in industry.

Piping System Offers Many Advantages

A piping system for anesthetics and oxygen offers a number of advantages to a hospital. It supplies

many locations with a minimum of equipment. It eliminates unsterile cylinders from nurseries, premature and operating rooms. It does away with cartage of cylinders through halls, and there is no accident hazard from cylinders standing in patients' rooms.

Costs are reduced to a minimum—labor saving alone can halve the expense of supplying gas to individual cases. Emergency cylinder replacements are eliminated, and nurses and anesthetists never touch or handle cylinders. The maintenance crew of either the hospital or the cylinder supply company replaces empty cylinders systematically.

These advantages are typified in the newly completed Columbus hospital addition on Chicago's lake shore, which has one of the most complete oxygen and anesthetic gas piping systems installed thus far. The system includes oxygen, nitrous oxide, helium, carbon dioxide, air pressure, vacuum and a spare pipe for any new gas. Helium is piped to be mixed with ether, ethylene or cyclopropane in the room where the anesthetic is used.

Oxygen Outlet At Each Bed

Columbus hospital has oxygen outlets between the beds and for every bassinet. This makes it possible to furnish oxygen to patients anywhere in the hospital, the importance of which was emphasized several years ago when quadruplets were born in a hospital piped for oxygen but with a limited number of outlets. It was possible to give only one quadruplet oxygen until cylinders were brought from the supply warehouse, trucked through the hospital, up the passenger elevator and taken into the nursery without sterilizing.

The gas outlets in patients' rooms are at eye level and between the beds; the outlets are tamperproof and of neat appearance. They are simple to maintain, easy to keep sterile.

There are resuscitators and aspirators on every floor. They connect into the gas outlets provided next to every bed in the hospital. Portable resuscitators and aspirators cost so much less than complete tank operated units that it was possible to supply them for the entire hospital rather than for surgery, OB, and emergency only.

Resuscitators operate by means of alternate pressure and vacuum—13 mm pressure and 9 mm vacuum. This differentiates them from pulmotors, which work on the principle of specific volumes of gas supplied and withdrawn. The aspirators connect to oxygen outlets and provide aspiration with trigger control.

Quick Connectors Identified by Color

Quick connecting snap couplers, with a positive metal to metal method of locking in, are identified by color bands clearly identifying the service according to code: oxygen, green; nitrous oxide, blue; helium, brown; carbon dioxide, orange; vacuum, white; and compressed air, yellow. Internal construction of the couplers makes it impossible to insert the wrong one.

The piping arrangement in the operating and delivery rooms is the same in each outlet. Vacuum valves are on the left on the panel, and second from the left is compressed air. Oxygen is on the right side, with nitrous oxide next to it.

Cost per Outlet of the Piping

While piping an existing building costs an average of $70 to $80 per outlet, new construction is $60 to $70 per outlet. Based on the prospective life of an average new hospital, this is $2.50 per outlet per year—usually less than the annual labor cost to wheel cylinders from the loading dock to the patients' rooms.

The oxygen supply manifold is located close to the delivery dock in the Columbus hospital addition to keep the movement of cylinders to a minimum. It is good practice to supply four times the average daily cylinder consumption, and the minimum manifold installation is twice the average daily consumption. However, the oxygen cylinders at the Columbus hospital are used only as standby equipment.

The Columbus hospital will use enough oxygen to warrant purchasing it in bulk quantities. To do this, supply equipment was installed to hold 50,000 cu ft of liquid oxygen at 60 lb pressure. Bulk oxygen is delivered in a special tank truck and pumped into an above-ground enclosed reservoir at the hospital. By purchasing oxygen in large quantities, the price drops materially.

The ball-shaped liquid oxygen container unit in the yard back of the hospital is connected to the oxygen system with underground piping. This piping is protected by a double thickness of tarred felt roofing paper wrapped and tied at 18 in. intervals. During normal oxygen consumption in the hospital, enough gas is drawn off the liquid oxygen in the insulated container to keep its pressure low.

The oxygen and anesthetic gas manifolds in the hospital automatically switch from empty to full cylinders, eliminating the possibility of cylinders running out of oxygen while the patient is in a critical condition or during the administration of an anesthetic. When the manifold makes the switch, a gage reading changes from green "Service" to red "Reserve". This allows from 12 to 24 hr to replace empty cylinders under normal usage.

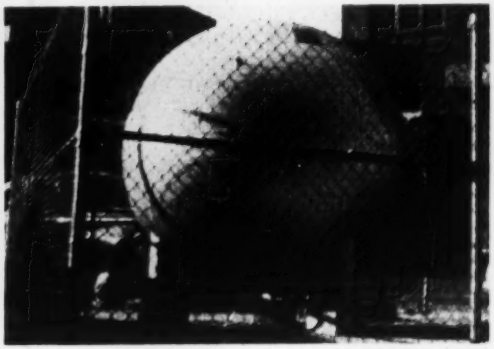
In addition to the "Service-Reserve" gage on the manifold throw-over, many hospitals install gages in the operating rooms, nurses' office and on the engineer's control board. There are also alarm systems in case the reserve cylinders deplete their supply due to lack of attention. The alarm is connected into the gas line and simultaneously rings a bell and switches on a warning light if the pressure drops below the reserve pressure.

Shutoff Valves on Each Floor

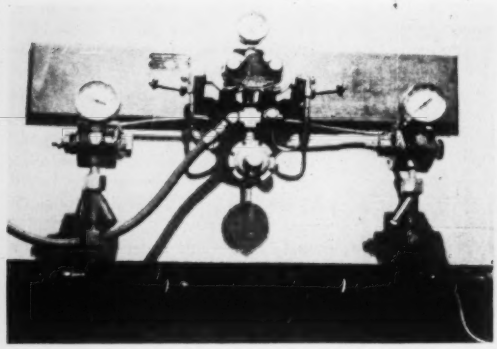
Each floor of the Columbus hospital addition has its own oxygen and anesthetic gas shutoff valves. These section shutoff valves are located in stainless steel cabinets in the corridors. The cabinets are labelled and clearly identified. The valves themselves are numbered and provided with nameplates. The nameplates tell which section of the hospital the valve controls. A warning says that the valves are to be on at all times except in case of emergency.

Extreme caution must be taken so that no sections will be shut off where patients are receiving oxygen. However, in case of emergency the whole system or any section of it can be turned off. Engineers and nurses have location charts which show the location of all section shutoff valves, and the areas they control.

AMOUNT OF OXYGEN delivered through the flow meter is adjusted by Nurse Margaret M. Gewecke. Humidifier in meter releases water vapor into oxygen

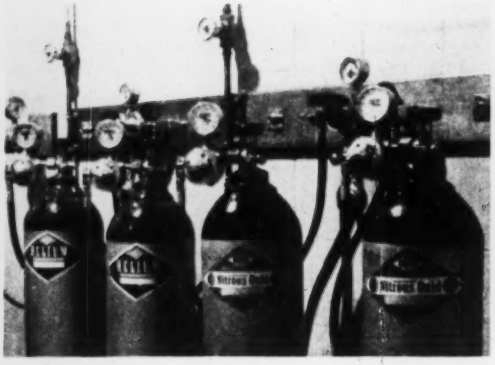


BULK OXYGEN is delivered to this ball-shaped container at the hospital by special tank truck. Oxygen in cylinder manifold is used for standby

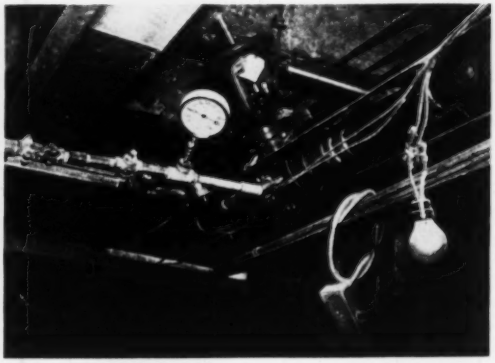


OXYGEN MANIFOLD controls. Supply cylinders and valve with gage are on right, reserve on left. Equipment in center throws system onto reserve

SUPPLY CYLINDERS attached to manifold, with replacement cylinders at right ready to be attached to manifold when the supply cylinders have been emptied



HELIUM AND NITROUS OXIDE cylinders with their automatic regulating and reducing valves. The gages show the pressure being delivered into central systems



PIPING WAS TESTED at 200 psi by means of water pumped (oil free) compressed air for 24 hr. This photo shows shutoff valve and gage for making the test

Section shutoff valves are of the diaphragm, packless, double seating type. They back seat tightly so the diaphragm can be replaced without shutting down the whole system.

Cleaning the Pipe and Fittings

Prior to installation, the pipe, fittings and valves for oxygen and anesthetic gases were immersed in a tank of hot, agitated trisodium phosphate for 15 min or longer to remove all grease, oil and dirt. The solution was then rinsed off with water.

The oxygen and anesthetic piping in the Columbus hospital addition is type K hard seamless copper tubing. The smallest size used is $\frac{3}{8}$ in. nominal to serve from one to 12 outlets. One-half in. tubing is used to serve from 13 to 100 outlets, and $\frac{3}{4}$ in. for 100 to 500 outlets. The pipe main from the manifold is 1 in. Risers to the different floors are $\frac{3}{4}$ in., and $\frac{1}{2}$ in. horizontal mains spread out at each floor level.

There are 180 oxygen outlets in the hospital addition, and each outlet can normally supply nine liters per minute. This means that the sizes of pipe used are adequate to convey the gases with no appreciable pressure drop.

Long sweeps were used throughout the installation. Before bending, the tubing was annealed by heating it to just below the point where it turned red—600 to 650 F. The tubing was shaped with bending tools to avoid flattening, buckling or thinning of the tube wall at any point. All turns with a radius less than seven times the outside tube diameter were made with solder fittings.

Installing the Copper Tubing

The tubing was installed so it stuck out of the wall 4 or 5 in. Then it was pinched off and soldered shut. The system was subjected to a preliminary test, and if the pressure dropped, a soap bubble test of tube joints was made.

After the walls were plastered and painted, hacksaws were used to cut off the pipe stubs even with the wall. During cutting, the pipes were placed in jigs so they would be cut off the exact distance from the wall. A terminal nipple was then sweated onto this stub using a carbon resistance soldering unit to protect the chrome finish. Terminal snap couplers were installed with a thin paste of litharge and glycerin applied to the first three threads only.

All oxygen and anesthetic lines were grounded to the water supply system to reduce the possibility of static electric discharges.

After installation, each section was tested at 200 psi by means of water pumped (oil free) compressed air. If the system wouldn't hold 200 psi with 0 lb pressure drop for 24 hrs, all connections were tested for leaks with soapsuds and the test repeated after repairs were made.

It is a general rule that pipe lines for this type of service are tested at approximately 10 times normal working pressure.

In addition to copper tubing for oxygen and anesthetic gases, the Columbus hospital addition has copper pipe for hot water, cold water, soil stack, waste lines and vent lines. This is believed to make it one of the largest copper pipe installations in the middlewest.

Joints were sweated with either 50-50 solder or silver solder depending on the pressure, characteristics and properties of the liquid or gas to be transported in the pipe. Propane gas was used in the torches for soldering because of the lower temperature. When sections of the general piping system were completed, they were tested under approximately 100 lb air pressure. When this test indicated a leak, the joints were soaped to locate it. When this did not locate the leak, a small amount of "Freon" was charged into the system, and the piping was gone over with a halide torch leak detector.

The hospital addition will have about 100 beds and approximately 600 plumbing fixtures. The main section has a full basement and six stories. The tower section is 10 stories high.

One section of the basement is devoted to kitchen equipment, all of which is piped with copper. There are gas ranges, steam tables, a walk-in refrigerator, a refrigerated meat box, a vegetable refrigerator, and a food freezer. The kitchen was designed to serve three meals per day to 1000 people.

There are two 250 hp high pressure scotch marine boilers to heat the building and to supply steam to various items of kitchen and sterilizing equipment. They burn gas during the summer and oil in winter. The boilers serve a pair of steam-to-water heat exchangers for a two pipe upfeed, forced flow, self-venting hot water heating system. There are vents on high points of the piping system but none on the convectors. Steel pipe was used for the heating system with $\frac{1}{2}$ in. runouts to the convectors.

Heating and Air Conditioning

There are two heating zones, and the reverse return system is used. The supply mains are in the basement, and the return main is in the top story of the building. Indoor-outdoor thermostats control the heating system.

Air conditioning equipment is in the basement to supply conditioned air to the operating corridor, the OB corridor, and the nurseries. All these rooms have double-glazed windows. The equipment consists of a 40 ton direct expansion condensing unit, water chillers, supply fans, blast coils, washer type humidifiers, and chilled water coils. Each air conditioning zone has individual temperature and humidity control.

None of the air is recirculated. There are exhaust fans on the sixth floor which discharge the air on the building setback behind the tower. There are separate exhaust systems for the kitchen, for the washrooms, and a fume exhaust system for the laboratory.

Most of the mechanical equipment is in the basement. The first floor is devoted to laboratories, X-ray rooms, offices, and lobby. The second floor has operating rooms, and rooms for patients. Nurseries are on the third floor. The remainder of the building is general hospital space including patients' rooms, linen closets, washrooms, etc.

The Columbus hospital and addition, as well as other hospitals all over the world, are owned by the Missionary Sisters of the Sacred Heart. Leonard Anthony Gliatto was the architect, E. R. Gritschke the engineer, Warner Construction Co. was the general contractor, and Oxygen Equipment and Service Co. installed the oxygen and anesthetic piping.

AT "REFLECTION POINT," indoor comfort is achieved at roughly one-third the calculated heating or cooling loads with more conventional air conditioning methods, says Dr. Mills. Outside air is brought in for ventilation and pressurization, is unchanged except for cleaning

Radiant Conditioning In Use at "Reflection Point"

Clarence A. Mills, Ph.D., M.D., professor of experimental medicine at the University of Cincinnati, has long been famous for his studies and writings on the effect of climate on man, and on control of body heat loss by radiant means. He has installed reflective conditioning in his new house — "Reflection Point" — and believes it important that heating, ventilating and air conditioning engineers become acquainted with its possibilities and conditions of operation. According to Dr. Mills, the new method has applications in many types of buildings, including residences, apartment houses, hotels, ships, planes, automobiles, military tanks, boiler rooms, and other radiantly "hot spots"

TWENTY YEARS of worldwide study and extensive laboratory investigation preceded erection of the experimental house at "Reflection Point," in Cincinnati. These studies indicate that man's energy—his mental initiative and physical vitality—is in large measure dominated by the ease with which he can get rid of his body's waste heat. So long as he can dissipate this heat readily, he is an energetic and industrious individual; when his heat loss becomes difficult, he tends to slump into a relaxed "vegetative" existence.

Half of humankind over the earth faces continual difficulty in such body heat loss and is held down to a sluggish pace of life. Another quarter needs cooling half of each year. Only in outer temperate regions does winter heating become of real importance and then only for a minor fraction of the human race. Biologically speaking, therefore, hot weather cooling has far greater importance to mankind than does cold weather heating.

It is not only man's energy and initiative which decline in the heat. Growth rate, speed of development, resistance to infection and other measurable indices of vitality are also involved. Man is a combustion machine working at about the same low efficiency as a well-tuned automobile engine. Most of his combustion energy must be dissipated as waste heat, and prolonged difficulty in such dissipation results in a banking of his tissue fires so that there is less heat to be dissipated.

It is this biologic viewpoint which prompted my entry into the interior conditioning field almost two decades ago. Further urge came from a conviction rather widely held among medical people that sharp contrasts between inside and outside air tend to increase human respiratory troubles.

Almost 13 years ago, in January 1938, our laboratory studies on control of body heat loss through radiant channels were presented before the annual meeting of the American Society of Heating and Ventilating Engineers. Those studies demonstrated the biologic feasibility of "reflective radiant conditioning," irrespective of air temperatures or humidity; and they gave some hint of the structural and operative economies which might result. Today, at Reflection Point, stands the world's first example of reflective radiant conditioning, in successful operation for both winter heating and summer cooling. Already this field testing

has brought to light several points of great practical importance in the conditioning of buildings for human living.

This experimental house is by no means a minimal demonstration unit for assembling test data; instead, it is a beautifully designed and elegantly furnished ultramodern home in which will be studied all the intricate phases of this new type of conditioning and its general impact on the problems of living. While the structure, on its bluff site overlooking downtown Cincinnati, is one of the city's showplaces, it is also a veritable laboratory—wired for everything except sound!

Construction of "Reflection Point"

In drawing plans for the house, we purposely included no particular structural specifications bearing on the conditioning system. So far as the reflective radiant conditioning was concerned, our interest centered only on the inner surfaces facing the room occupants. We therefore used a regular uninsulated frame prefabricated structure. It contains no conventional insulation and has a calculated heat loss rate of 133,000 Btu per hr at 0 F outside when the indoor temperature is held at 70 F.

Of its 1600 sq ft of exterior wall surface, 600 sq ft is single pane glass (mostly $\frac{1}{4}$ in. plate). The house is "solar" only in being oriented on an east-west axis, with a 4 ft roof overhang to keep the summer sun off the south wall but let the more slanting winter sun's rays flood freely into all rooms with southern exposure. It sits on an uninsulated concrete slab. Its roof is flat, without air space or insulation, and with rain water drainage down copper standpipes in interior walls.

Foil Wall Coverings Act As "Heat Mirrors"

The interior treatment is where our primary interest centered. All sidewalls and ceilings are papered with embossed and tinted foil wall coverings. The lacquer used in applying the pigments to the foil surfaces is heat transparent, and only those pigments were used which do not lower the foil surface reflectivity more than 10 percent below the 97 percent of the uncovered foil. Application of the foil wall coverings to the insulation board walls was the same as for conventional wallpapers, except for the addition of 2 percent of potassium chromate to the gluten paste to minimize possible seepage damage to the foil.

These foil wall coverings function as effective heat "mirrors" with a reflectivity close to 90 precent for radiant heat. At the same time they constitute an 80 percent effective barrier to radiant heat emission into the room from exterior sources.

All foil surfaces used are decorated by embossed patterns, so that heat rays striking them are broken up into an even intensity throughout the room. Shadows, or hot and cold spots, are thus avoided.

Floor treatment consisted of placing ordinary foil insulation paper face upward on the concrete slab, then covering this with a waffle design foam rubber underlay with the waffle design downward to give point contact with the foil. The final covering is nylon carpeting; any variety of carpeting can be used, however. The floor treatment allows but little of the radiant heat introduced into the room to go on downward into the concrete slab.

Treatment of the large glass areas to control radiant heat flow either inward in summer or outward in winter is threefold: (1) aluminum slat ventilation blinds, (2) draperies of satin cloth with one face aluminized, and (3) draperies woven with a heavy nylon warp and an inner facing of almost 80 percent foil yarn exposure for heat reflectivity. Careful tests showed that either type of cloth drapery gave roughly 80 percent blockage of radiant heat, while the aluminum venetian blinds did slightly less well.

Our structure thus functions fairly well as a reflective box for inside radiant heat, with its interior radiant environment largely independent of that outside. All this was accomplished with no conventional insulation to prevent kinetic heat flow into walls, floor and ceiling from contiguous air on either side.

Cove Near Ceiling for Heating, Cooling

In this heat reflective box was next installed a cove or trough going around each room up near the ceiling, in the bottom of which are "Freon" coils for radiant heat removal in summer and electrical resistance rods for radiant heat input in winter. These troughs are lined with sheet aluminum and equipped with drain pipes to carry away moisture condensing on the cold coils in summer. Radiant heat input in winter or its removal in summer is by reflection from the foil ceiling covering.

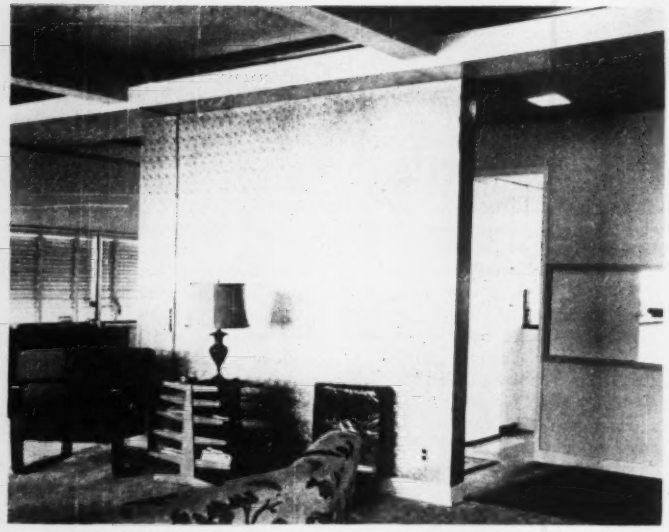
The only air cooled in summer is that lying in the trough, careful tests never demonstrating any spillage of this chilled air over into the room. In winter, the resistance elements heat only the air layer against the ceiling. No heating rods are allowed to go above 250 F, so that there will be no emission of the skin-irritative shorter wavelengths.

Just a word about the control system. Off the central hall are five thermostats, one for cooling control and four for heating. When air temperatures are above 74 F, cooling is available to any part of the house. It does not reach any room, however, until the individual room switch is thrown to open that room's solenoid valve. The four other thermostats make available four different degrees of voltage and heating capacity for the elements in any room whenever the room switch is thrown on.

All this took considerable planning and electrical equipment of no particular interest here. Most future reflective radiant conditioning installations will probably use hot and cold water circulating through cove elements, rather than electrical resistance elements and refrigerant coils in the room coves. We chose direct-electric resistance heating for study purposes because of its accuracy of metering, control and maneuverability. In commercial installations one would use the cheapest fuel available.

Electrostatic Filter Cleans the Air

The house has an electrostatic air filter unit in the basement, equipped with a fan of 300 and 1000 cfm calculated capacity for forcing the filtered outside air into the house. This cleansed air enters the upstairs through the entire central hall ceiling (of acoustically perforated aluminum sheet) without perceptible drafts anywhere, even at 1000 cfm volume. There is no heating, cooling or humidity change in this air, nor is there any recirculation. Its primary



FOIL COVERINGS—embossed to break up the heat rays for even intensity throughout the rooms—are used on interior sidewalls and ceilings. The hall has an aluminum acoustically perforated ceiling through which cleaned air is introduced

purpose is for ventilation and pressurization of the structure so that all crack or aperture seepage will be outward. More will be said of its operational results later.

Heating and Cooling Results

We have had entirely satisfactory heating operations at 62 percent below conventionally calculated loads during the period from April to mid-October of 1950. Heating was required on 13 of the 19 days while this article was being written. On these 13 days there was an average of 12.2 F difference between inside and outside mean daily temperatures and an average electrical consumption of 0.213 kwhr per F temperature difference. Considering a kilowatt as equivalent to 3410 Btu, it took only an average of 726 Btu per hr per deg temperature difference to produce comfort through these 13 days needing heating, whereas conventional calculations of heat loss from the structure indicate a need of 1900 Btu per hr. The heat load actually required was thus only 38 percent of the calculated.

Mean daily temperatures ranged from 70.9 F down to 60.3 F indoors and from 63.8 F down to 51.8 F outdoors during this period of 13 heating days. Obviously, human comfort could not have been achieved through air heating at these air temperature levels. With the cold surfaces of uninsulated walls, it is more likely that air temperatures of 74 F or above would have been required.

Preliminary cooling load observations during the past summer indicated similar savings. Really accurate cooling studies must await another summer's heat, for there was no coverage of the large glassed areas during the early summer's severe warmth, and other items of change and adaptation through the summer months made accurate quantitative studies impossible.

However, we did observe a fairly comfortable cooling effect throughout the house with roughly 1½ tons of refrigeration (18,000 Btu per hr, plus or minus), whereas much more than this amount of refrigeration would have been required for comfort by conventional air cooling.

On the summer's hottest day (96 F maximum, with 78 percent relative humidity), the inside maximum temperature was 89 F and the wet bulb reading was the same as outdoors. Even so, fair comfort for sedentary activity was achieved and a sweat-free siesta was possible.

In laying out the cooling system, the basis for radiant cooling was the removal of about 500 Btu per hr per person, calculating for 12 people in the living room, eight in the dining room, five in the study, three in each bedroom, two on the porch, and three in the kitchen, or a total calculated cooling capacity of 18,000 Btu for the whole house. Distribution per room was calculated on the basis of 32 lineal feet of ⅜ in. copper tubing per person. This involved much empirical guesswork but seemed the most logical basis for computing cooling needs for this new system of unknown performance.

Toward the end of the summer, as we achieved more complete control of radiant heat leakage into the house, it became evident that adequate cooling could be attained regardless of air temperature or humidity. Power requirement for the compressor, with the cooling on in all rooms, was slightly over 2 kw per hr of operation.

Condensation on the cold coils was heavy on humid days but produced no detectable reduction in indoor humidity, due to the large volume of outside air continually being pumped into the house through the electrostatic air filter.

Having little concern about indoor temperatures and humidity, we were enabled to bring in outdoor air as needed to pressurize the house and secure outward seepage through all cracks or open apertures. Nothing was done to this air with regard to its temperature or humidity—only electrostatic filter cleansing. A two-speed fan is used (calculated capacity of 300 and 1000 cfm), operating at the higher speed only when large numbers of people in the house call for maximal ventilating effect. As many as 50 people (most of them smoking) have been in the house for 2 to 3 hr without noticeable smoke or odor accummulation. Even the faintest traces of tobacco smoke have disappeared within ½ hr after the people have left.

Such pressurizing of the house has brought almost complete freedom from the heavy dustfall so prevalent in other houses of the neighborhood. Turning off the air filter's power pack but continuing the physical filtration, we retain interior cleanliness but suffer from a disagreeable

musty staleness of the air. With the power pack turned on, there is always sensed complete freshness of the air on entering from the outside. All pollens are also removed.

Comfort With One-Third the Load

In brief summary, therefore, we seem, first, to have achieved indoor comfort through reflective radiant conditioning at roughly one-third of the calculated heating or cooling loads with conventional air conditioning; and, second, we are able to bring in outside air (unchanged except for cleansing) as desired for ventilation and pressurization of the structure to secure effective outward seepage and freedom from neighborhood dirt. Although we use electric resistance heating with an intricate system of control and recording of results, our final results in load savings are applicable to the use of any fuel and to hot or cold water circulating through the room coves for radiant heat input or removal.

Our present step is to set up rooms with identical heat loss, cubage and exposure values to determine more exactly the conversion factor to be used in going over from conventional air conditioning calculations to those applicable to the new system. These rooms should yield the desired information within the next month or two. The system should therefore be ready for practical use by the early spring of 1951.

Public acceptance of the new foil wall coverings has been enthusiastic and unanimous. We had anticipated great acoustic difficulties from the metallic wall surfaces—and such are present in the enclosed stairway well and in the garage, which have the foil wall coverings but no coves. Every room with coves has perfect acoustics. We had even ordered draperies to cover whole walls for sound deadening, and so were pleasantly surprised at the results unintentionally achieved by the cove design.

Many Applications of the New Method

Applications of this new type of conditioning should cover almost all types of human habitations, except those of heavy occupancy such as theaters, auditoriums and the like. Private residences (old or new), apartment houses, hotels, ships, planes and a great variety of other enclosed spaces can thus be conditioned advantageously.

One such large residential building is expected to go up soon in downtown Detroit and to use the new system. This is to be erected by the cooperative Residence At-Ease Association, and similar projects are being organized in a number of other cities across the country. Interior cleanliness in the dirty downtown and industrial districts of our cities will be a great boon indeed, especially since it can be achieved simultaneously with a marked reduction in heating and cooling costs.

This new type of conditioning should not be considered as another type of economical winter heating. It is year 'round conditioning "in a single package." Its winter fuel saving advantages cannot be taken separately, for the foil wall coverings will make summer heat unbearable if no cooling is provided. Only in far northern regions or tropical highlands without indoor heat problems could its fuel savings for heating purposes be used alone.

It should prove particularly economical as a cooling system for tropical lowland countries, since it avoids the need for extensive insulation and does not require a closed structure for effective operation. In fact, our preliminary studies have indicated that we may be able to heat and cool from the ceiling area alone by the new system.

During April we had outside temperatures as low as 19 F at Reflection Point, and as low as 51 F indoors in the early morning. Complete comfort was achieved by radiant heat input. With only the living room heat on, one could stand between this room and the dining room and be cold on one side, warm on the other. Two steps into the living room brought warmth on all sides. The living room could be radiantly heated alone, even with three 8 ft apertures wide open to other unheated portions of the house.

Heating and cooling through radiant channels thus means that the interior of the house no longer needs to be tightly compartmented to secure localized comfort. Everything can be left wide open and still have heating or cooling as desired in any room.

No Condensation Problems Yet

Air conditioning engineers have expected us to encounter moisture condensation problems on windows and elsewhere through our lack of concern over surface temperatures. No such problems have yet appeared—perhaps they will as we encounter more rigorous winter weather.

This new system should not be thought of as a luxury to be available only to the few. The foil wall coverings will be priced in the same range as any good grade of conventional wallpaper. The installation of the radiant heating-cooling system should cost somewhere near the same as a good conventional heating system, but should operate at about one-third the conventional fuel load.

The system puts no particular requirement on the structure except that it provide an interior wall surface to carry the foil wall coverings. This is not strictly true, however, for we now know that low or flat roofed houses should not permit the hot summer sun to build up excessively high ceiling temperatures inside. Even the 20 percent emissivity of the foil wall covering on the ceiling will cause too much of this heat to be radiated onto the room occupants and cooling coils. Ideally, one should use a heat reflective outer roof surface for the flat roofed structure, or keep a thin layer of water there to prevent temperature rise.

Studying Flat Roof Treatments

At Reflection Point, we are studying various flat roof treatments to meet this heat problem—aluminum foil, or rolled sheet, renewable aluminum paint, and standing water. Another summer's experience should yield valuable working information.

We are particularly interested in carrying our studies on reflective radiant conditioning over into the clothing field (as has already been detailed in connection with the window draperies), and into such localized applications as seem possible in automobiles, military tanks, boiler rooms or other radiantly "hot spots". A whole new host of possibilities have been opened up by this approach to control of body heat loss through radiant channels.

Methods of Making

PIPING FLEXIBILITY

Analyses

Theodore E. Bridge Continues Explanation of Figuring Piping Flexibility by Scheme Which Has Been Found Useful by Himself and Others

A PIPING flexibility problem was solved in the November issue by means of the method proposed by C. T. Mitchell, and also with the thrust axis located correctly. This month, a solution will be made with the thrust axis located empirically.

Locating Thrust Axis Empirically

In solving the problem in Fig. 10, the thrust axis is empirically located in the following manner.

1) Draw Mitchell's axis through the center of gravity and parallel to the direction in which the expansion takes place (line *mO* in the figure).

2) Draw the center of gravity axis through the center of gravity of each half of the system (line *POQ* in the figure).

3) Draw the thrust axis halfway between the above two axes. In other words, bisect the angle between the center of gravity axis and the Mitchell axis (line *bOg* in the figure).

Thus it is seen that the angle C is abitrarily made equal to one-half of angle C''. $C = C''/2 = 26/2 = 13$ deg.

Area A		Arm Y	Moment Area M
0.8 x 3.5 / 2	= 1.40	0.53	0.7
3.8 x 16.5 / 2	= 31.3	2.5	78.3
3.8 x 3.9 / 2	= 7.4	2.5	18.5
3.9 x 6.1 / 2	= 17.9	3.7	66.3
5.6 x 2	= 11.2	5.6	62.9
5.4 x 5.6 / 2	= 15.1	5.6	54.5
4.3 x 4.4 / 2	= 9.5	2.9	27.5
Total			308.7

From equation 22, $Z'' = 12\ e\ T\ L'' = 12 \times 0.00000625 \times 400 \times 22 = 0.66$.

According to equation 23 [page 97, November HPAC], $F = \cos C\ Z''\ E\ I / 1728\ M$. Therefore, $F = 0.975 \times 0.66 \times 29 \times 3 / 1.728 \times 0.3087 = 105$ lb.

According to equation 16 [p. 94, November HPAC], $S = 6\ F\ Y_{max}\ D'' / I = 6 \times 105 \times 5.9 \times 3.5 / 3 = 4340$ psi. Thus, the assumption made in solving this problem yielded a value for thrust which is 3 percent low and a value for stress which is 4 percent high.

Thrust Axis Need Not Be Accurate

As a result of considerable study, the author has decided that it is usually unnecessary to locate the thrust axis accurately when using the short-cut method as demonstrated in Fig. 10. It is seen that accuracy is not obtained by using the Mitchell assumption, but there are many problems where accuracy of a high order is not required. It is usually cheaper to increase the factor of safety than it would be to refine the calculation.

It is believed that, if a probable error of 10 percent can be tolerated, it is justifiable to simply draw in the thrust axis by eye without making any calculation as to its exact location. This is justified for several reasons, which are given in the following paragraphs.

In the first place, a great deal of time is saved by this method. It is quite tedious to locate accurately the exact center of gravity of a complicated piping system.

In the second place, the eye is very sensitive to errors made in locating the center of gravity. The author has frequently been called on to check calculations made by others. It is very surprising how often a designer will make a mistake in calculating the location of the center of gravity; and, being lost in figures, he draws the thrust axis through a point which is quite obviously not the center of gravity. It is believed

Mr. Bridge acquired a wide experience in the design of power and process piping during 15 years with E. I. du Pont de Nemours & Co., and has also had experience in the field of very high pressures. At the time he prepared this article, he was a mechanical engineer with the University of Chicago in connection with a project under construction for the Argonne National Laboratory; he is now associated with Tube Turns, Inc. He has taught several other engineers to use the method described here in figuring flexibility of piping systems, and they have found it as useful as has he.

that most inexperienced calculators would make a better score if they would just imagine at what point on the drawing the piping could be made to balance and then draw the thrust axis through that point. The eye is surprisingly accurate in picking this point.

In the third place, no great error is made even if the thrust axis does not pass absolutely through the center of gravity. If the axis is incorrectly located, a certain amount of moment area is added to one side of the system, and not quite the same amount is subtracted from the other; but only a small change in the answer is made by a very appreciable mislocation of the thrust axis.

In the fourth place, no anchors are likely to be perfectly rigid; so the assumption of the thrust axis passing through the center of gravity of the piping was inexact to start with.

If one wishes to compare roughly two alternate piping systems for flexibility, one needs only to imagine that he is going to spin the piping about the thrust axis. The system which seems to have the greatest flywheel effect will have the most flexibility.

The above imaginary visualizations are a great help in getting a check on the calculation. Very often, errors which might otherwise be difficult to find are quickly discovered by recourse to such visualizations—and with practice they become increasingly effective.

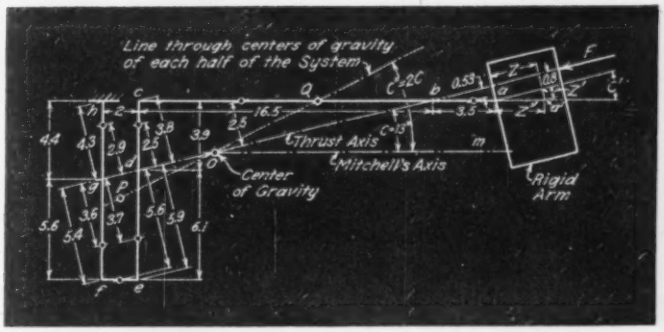


FIG. 10—PROBLEM shown in Fig. 7, given in November, is solved here with the thrust axis empirically located

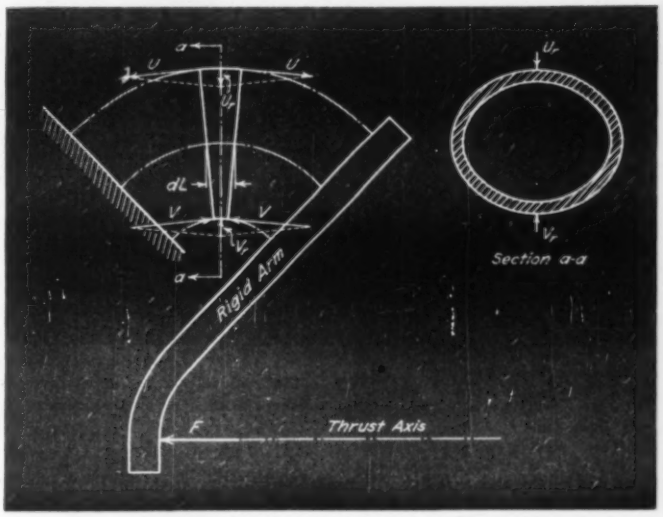


FIG. 11—BENDING STRESS in the wall of a pipe bend tends to cause the section to flatten, as shown here

Flattening Effect at Bends and Elbows

In addition to the other corrections to Mitchell's method described in the preceding paragraphs, it is also necessary to correct the calculation for flattening effect which occurs at pipe bends. Whenever a pipe bend is subjected to bending strains, the cross-section of the pipe at the bend is distorted. A circular section tends to become elliptical, and this change in section tends to make the bend much more flexible than would be indicated by the theory explained in the preceding paragraphs.

A 90 deg pipe elbow is shown in Fig. 11. One end of the elbow is shown anchored and a rigid arm is attached to the other. A force F is applied to the rigid arm, and the thrust axis is defined as the line through which the force F acts. As the force F is applied, the elbow will be subjected to bending stress—tension U in the outer fibers and compression V in the inner fibers.

Consider the action of these stresses on a short element of the elbow with the length dL. The tension stress may be represented by two vectors U which produce a resultant force Ur acting downward on the element dl as shown in section aa of Fig. 11. Similarly, the compression stress will produce a resultant force Vr acting upward. The two resultant forces will be equal and opposite.

It is obvious that the forces Ur and Vr will tend to distort the circular cross-section of the pipe into an elliptical section as shown in section aa of Fig. 11. The elliptical section will have slightly less moment of inertia than the original circular section, but this produces only a minor effect on the flexibility of the piping. There is produced, however, a very large effect as the section flattens. This is caused by the fact that, in the flattened position, the outer fibers find that they do not have to stretch nearly as far to accommodate a given angular displacement of the rigid arm. Similarly also, the inner fibers do not suffer so much contraction to accommodate the same angular displacement of the rigid arm. It all adds up to a system which is much more flexible than would be indicated if this flattening effect were ignored.

The flattening effect described above has been analyzed by three investigators—Marbec, Lorenz and von Karman. The latter gives a

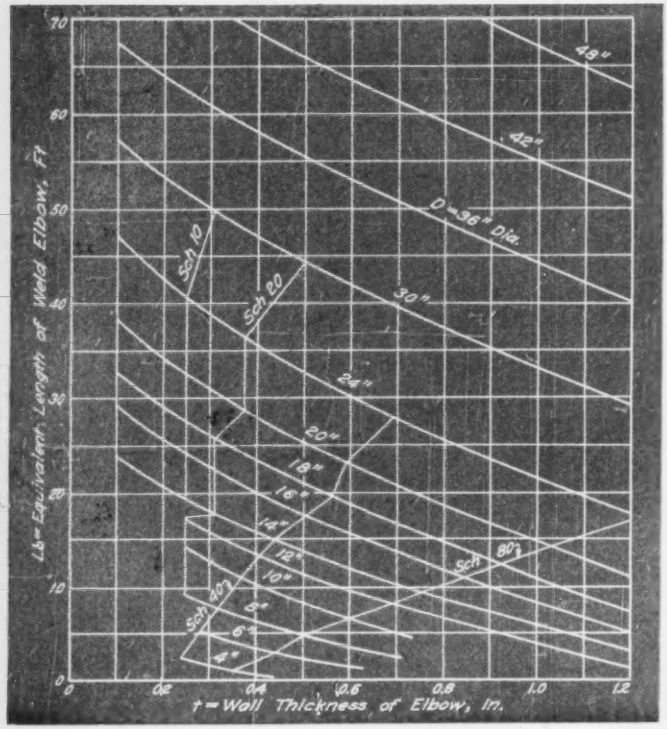


FIG. 12—EQUIVALENT LENGTH, *Lb*, of weld elbows in which the radius *R* is equal to 1.5 *D*, the diameter, may be calculated by these curves

formula which has been checked experimentally by Professor Hovgaard as reported in the Journal of Mathematics and Physics, published by Massachusetts Institute of Technology, 1926-27, pages 69-118. It is the purpose here to develop a simple way of correcting the calculation to evaluate properly the effect of this flattening on the flexibility of the piping.

It is proposed that the flexibility first be calculated by using the moment area concept previously described, and then a separate correction made for the flattening effect. In other words, the moment area will first be calculated, assuming square corners and ignoring the flattening effect. The extra flexibility produced by the flattening effect at each elbow will be expressed as equivalent additional length of straight pipe. The equivalent length of each elbow will be multiplied by Yb^2, the square of the distance from the elbow to the thrust axis. This will give the additional moment area produced by flattening at the elbow:

$$Mb = Lb\ Yb^2 \quad \ldots\ldots\ldots [24]$$

where *Lb* is the net equivalent length of the elbow over that already included in a square corner assumption, and *Mb* is the net moment area of the bend. It will be added to the total previously calculated on the basis of a square corner assumption, to obtain the total for the system.

Consider a 90 deg pipe bend with radius *R*, *R* being given in inches. Such a bend will have an actual length (in feet) equal to a quarter of a circle, or $(\pi R/24)$. Von Karman gives a factor *K* which is to be multiplied by the moment of inertia *I* to obtain the equivalent moment of inertia of the bend. Rather than reduce the moment of inertia of the pipe, it is proposed to increase the length of the elbow. This will produce the same effect in the calculation. Thus, the gross equivalent length of the bend is

$$Lb' = \pi R/24\ K \quad \ldots\ldots [25]$$

The object of this calculation is not to determine the gross or real equivalent length of the bend; it is rather proposed to calculate the net increase over that already included in the calculation based on a square corner assumption.

In order to calculate the net equivalent length of the bend, it is necessary to subtract the actual length of pipe included in a square corner assumption from the gross equivalent length of the bend:

$$Lb = Lb' - 2\ R/12 \quad \ldots\ldots [26]$$

Substitute [25] in [26]:

$$Lb = (\pi\ R/24\ K - R/6)$$

$$= R\ (1/7.63K) - R/6 \quad \ldots\ldots [27]$$

Von Karman gives the following value for *K*:

$$K = (1 + 12h^2)/(10 + 12h^2) \quad \ldots\ldots [28]$$

where

$$h = 1.1\ t\ R/D^2 \quad \ldots\ldots [29]$$

and where *t* is the wall thickness of the pipe bend, in.; *R* is the radius of the bend, in.; and *D* is the mean diameter of the pipe, in.

Equations 27, 28 and 29 were used to calculate a set of curves shown in Fig. 12 from which the equivalent length of a weld elbow, *Lb*, may quickly be determined. This figure applies only to weld elbows where $R = 1.5\ D$.

Quick Calculation of Equivalent Length

For other conditions, where *R* is not equal to 1.5 *D*, the scale given in Fig. 13 may be used to calculate quickly the equivalent length *Lb*.

It is recognized that the corrections obtained from the use of Figs. 12 and 13 are only approximate, but sufficient accuracy will be obtained for all practical purposes. An example at the end of this series of articles will illustrate the manner in which the flattening effect correction is applied.

For three plane problems—that is, for three-dimensional systems—it is not usually proper to apply the full value of *Lb* obtained from Figs. 12 and 13. There is no tendency for a pipe bend to flatten when it is subjected to twisting only. For most work, it is proper to neglect flatten-

ing effect when the bend is subjected to any twisting. If greater accuracy is required, the equivalent length Lb may be considered as a vector normal to the plane of the bend. If this vector is roughly projected along a line normal to the plane which contains both the thrust axis and the center of gravity of the bend, the component so projected may be used as the equivalent length of the bend. It would usually be very difficult to project accurately the vector in the manner described. No attempt at accuracy need be made. A visual inspection of the drawings will show roughly whether three-fourths, one-half or one-quarter of the vector Lb should be used in the calculation. It is repeated that, for most three-plane problems, the flattening effect may be ignored and the error will always be on the safe side.

For single plane problems with thin wall large diameter pipe, the flattening effect correction may be very large, as it is in an example to be given at the end of this series of articles.

Symbols Used in This Article

C is the angle between the thrust axis and a line joining the anchors.

C'' is the angle between the center of gravity axis and a line joining the anchors.

D'' is the outside diameter of the pipe, in.

dL is the length of a very short element of pipe, ft.

e is the coefficient of expansion of the material of which the pipe is made. (For steel, $e = 0.0000065$ per F).

E is the modulus of elasticity of the material in the pipe, psi. For steel, $E = 29,000,000$ psi. This value decreases as the temperature rises, but the value for e increases with rise in temperature. These two terms are always multiplied together, so that no correction for changes in temperature need be made for steel for all temperatures below 600 F.

F is the force applied to the rigid arm to simulate the effect of anchoring the pipe.

h is a constant (see equation 29).

I is the moment of inertia of the pipe cross-section, in.^{4}

K is a constant (see equation 28).

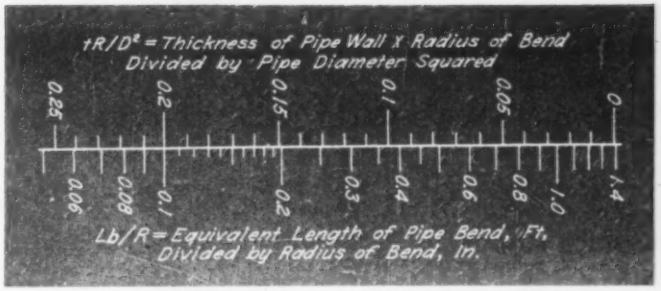


FIG. 13—THIS SCALE may be used to calculate equivalent length, Lb, of a pipe bend when R is not equal to 1.5 D, as it is in Fig. 12

L'' is the true distance between anchors, ft.

Lb is the net equivalent length of a pipe bend, ft.

LB' is the gross equivalent length of a pipe bend, ft.

M is the moment area, ft^4. $M = \int Y^2\, dL$.

R is the radius of the centerline of a pipe bend, in.

S is the maximum bending stress in the pipe caused by thermal expansion.

T is the difference between the operating temperature and the temperature at which the pipe is installed, deg Fahr.

U is the axial tension in the outer wall of a pipe bend, lb (see Fig. 11).

Ur is the resultant force acting in a radial direction to flatten the circular section of the pipe bend, lb.

V is the axial compression in the inner wall of a pipe bend, lb.

Vr is the resultant force which opposes Ur, lb.

Y is the perpendicular distance from the element of pipe dL to the thrust axis, ft.

Yb is the distance from the center of gravity of a pipe bend to the thrust axis.

Z is the deflection of the rigid arm parallel to thrust axis, in.

Z' is the deflection of the rigid arm measured perpendicular to the thrust axis, in.

Z'' is the vector sum of Z and Z', in.

[The next article by Mr. Bridge on piping flexibility will summarize the procedure in making calculations.]

AIR CONDITIONING STANDARD PROPOSED BY UNDERWRITERS

A Proposed Standard for Air Conditioning, Commercial and Domestic Refrigeration Equipment has been issued by the Underwriters' Laboratories, 207 E. Ohio St., Chicago 11, for industry comment.

For the most part, the proposed requirements are intended to bring Underwriters' Laboratories requirements into compliance with those of the ASAB9 safety code for refrigeration (adopted 1950); to incorporate in the requirements matters discussed with members of Underwriters' Laboratories advisory conference on refrigeration; and to coordinate in a single standard design and test requirements heretofore incorporated in separate standards for unit refrigerating systems and for air conditioning and commercial refrigeration equipment.

At the suggestion of industry advisory conference members, the condition of test at 60 percent relative humidity at 104 F (40 C) across evaporator and condenser has been established for room coolers. This will be the basis on which the ampere rating of room coolers shall be determined for the purpose of establishing wire sizes for internal wiring and service cords. Also, a static loading test on window type room coolers of 200 lb is specified.

The intent of the air conditioning requirements proposed is (1) to eliminate as far as practicable combustible insulation in the wiring of air handling compartments; (2) to require the use of an S-type (hard service cord or equivalent) in air handling compartments; (3) to require the use of noncombustible wiring and insulation in such systems where the wiring compartment is not completely metal enclosed; and (4) to require the use of inherently protected motors on air conditioning units which may be duct connected.

Studies on
HEALTH AND AIR CONDITIONING

Stress of the Physical Environment

How the physical environment—particularly temperature and humidity —affects the normal subject and the sick patient is clearly explained in this comprehensive discussion by Robert W. Keeton, M.D., professor of medicine and head of the department at the University of Illinois

In response to the ever-shifting viewpoints and techniques which the basic sciences are developing, medicine and its allied clinical disciplines have accepted the obligation to give human subjects, well and sick alike, the benefits of this newer knowledge. The physiologists have passed on much fundamental information derived from animal experimentation for trial on the human subject. The clinical investigators, in turn, have been confronted with problems posed by disease states which exist only in man and for the solution of which the techniques of physiology, biochemistry and biophysics must be applied.

American clinicians began their ventures in this field during World War I and have tilled the soil with increasing energy. As evidence of this, there are two large societies, one in the east and one in the central states, composed of young medical men devoting their energies to clinical investigation. Each of the societies has its own journal. The results of such investigations rapidly reach the medical men at large through the medium of postgraduate courses of short duration and programs of their county medical societies.

The viewpoint of medicine has been revolutionized and clinicians in increasing numbers are devoting their lives to the practice of academic medicine and teaching. The clinician who enters this field has devoted some four to six years to the solution of the practical problems of illness, and has for this reason a training somewhat better than the average college student who undertakes graduate work. The mechanistic viewpoint of disease has been held before him during these years. He has matured mentally because of this clinical instruction, but most of all he has learned to call for help from any person or discipline which can aid him. He has often been forced to return to the study of some particular basic subject so that he might use its techniques.

When the American Society of Heating and Ventilating Engineers suggested in 1935 to the department of medicine of the University of Illinois that it desired more information on the effects of the environment on the human subject, I and my associates accepted the assignment with considerable enthusiasm. In considering the suggestion, it seemed that this field should prove to be a most fertile one for exploration. It occurred to us that the study of sick patients might prove to be a useful tool in analyzing the reactions of normal subjects.

Our thinking was slow, tedious and bungling until we called for help from the department of mechanical engineering of the college of engineering. Here was a problem which was basically physiological, but upon which additional informa-

HOW PHYSICAL ENVIRONMENT AFFECTS NORMAL, SICK PEOPLE

1. In studying the stress of the physical environment on man, a cooperative investigative team composed of a physician, a physiologist and an engineer has worked together most satisfactorily.
2. When resting subjects in a steady state were exposed to hot environments and were forced to lose all of their heat by evaporation, there was no evidence of physiologic strain until heat was retained. With the retention of heat the pulse rate, cardiac output and the oxygen consumption were increased.
3. When normal subjects and cardiac patients were shifted from a comfortable environment to a hot moist one, allowed to remain there 1 to 2 hr, and then returned to the comfortable environment, the maximal alterations in pulse rate, blood pressure, mean skin temperature and evaporative water loss were accomplished within 10 min. Further adjustments manifested themselves slowly. At no time was there evidence of physiologic strain.
4. The loss of heat on the one hand chiefly by radiation and convection and on the other completely by evaporation is accomplished without physiologic strain. The presence of discomfort which represents the affective state of sensations under the latter conditions can hardly be considered as evidence of physiologic strain.
5. When heat is retained or extra heat is produced by shivering, physiologic strain becomes apparent.
6. Subjects and patients with heat retention are benefited by therapeutic exposure to cool dry environments.
7. It is important to develop methods for measuring the stress of non-uniform environments on the human subject.
8. Studies are in progress designed to measure the stress of high altitudes on cardiac patients and high oxygen pressures (five atmospheres) on animals.
9. There are advantages in and in some instances, it is necessary to provide a uniform controlled physical environment in a metabolic ward.
10. The stress of exposure to a physical environment widely distorted by heat, cold or low barometric pressures has been used to stimulate the adrenal and other glands of internal secretion.

tion was required. Doubtless this apparent lack of interest in the field was due to the technical difficulties of accurately controlling the environment. The ASHVE, on the other hand, had been doing excellent work for a number of years directed toward the solution of the immediate practical problems.

When Professor M. K. Fahnestock of the mechanical engineering department joined our group, we were immediately relieved of the problems of producing and controlling a given environment. He introduced us to the engineer's viewpoint, pointed out the problems which the engineer wished solved, and kept us from becoming engrossed in interesting side issues. In short, we learned to talk the language of the engineers, and were freed to undertake the study of the physiological problems involved. This type of cooperative investigation work proved to be quite fruitful during World War II and in the study of the stresses of the physical environment on man, it was considered that a team composed of members with the pertinent basic training was a necessity. The team in our studies was composed of a physician, a physiologist and an engineer.

I shall review now some of our experiences in this field and will select for discussion illustrations which should show the investigative and teaching value of the program. I will briefly point to the help which the studies have contributed to the therapeutic management of certain patients.

Studies of the Circulation

Man is a homiothermic animal. The ranges of body temperature within which the physiological processes may function relatively normally and life be maintained over any extended period of time are approximately 95 F to 106 F. Temple Fay (Reference 1) has reported certain refrigeration experiments in patients with cancer. The lowest rectal temperature recorded was 74 F, with death 4 hr later. Of those recovering (death rate 15 percent), rectal temperatures of 88 to 90 F were noted. Shivering usually prevented a drop below this point. The physiologic changes were altered in the direction of those seen in hibernation. In patients with rectal temperatures in excess of 106 F for an appreciable time, irreversible changes occur in liver and brain.

In considering man's relation to the environment, he may be regarded as a cylinder. This cylinder is divided physiologically into a central core and a surface shell. The central core corresponds to the viscera and muscles and it is here that the heat is produced. The surface shell is of variable thickness. In hot conditions it is thin so that the average body temperature (Reference 2) is computed from the formula $0.8R + 0.2 MT_S$, where R is rectal temperature and MT_S is mean skin temperature. In cold environments the shell is thicker and the average body temperature is derived from $0.65R + 0.35 MT_S$.

The heat is largely transported to the surface by the blood and is lost by the processes of radiation, convection and evaporation. The partition of heat loss between these three processes depends on the physical properties of the environment. For purposes of reference in the discussion which is to follow, Fig. 1 has been constructed from data derived from several sources. Among these are studies of Du Bois (Reference 2) and Winslow et al (Reference 3). The figures for heat production and partition are those of Houghten et al (Reference 4) and were derived from normally clothed seated subjects.

Reaction to Stress of Hot Environments

It is of course impossible to assign priority values to any specific physiological process. However, from the point of view of the clinical investigator, it is recognized that the circulation in man is extremely vulnerable and is commonly altered by various pathological processes. Heat production is a relatively stable process and the quantity produced can be measured and predicted from the surface area, sex and age of the individual. The environment can be established as desired with engineering assistance. Our first studies (References 5, 6, 7) concerned the stress of exposure of subjects until they attained a steady state to a hot dry environment (99.5 F dry bulb, 70.0 F wet bulb, corresponding to 22 percent relative humidity) and to a hot moist environment (99.0 F dry bulb, 85.0 F wet bulb, corresponding to 57 percent relative humidity) in which the air velocity was less than

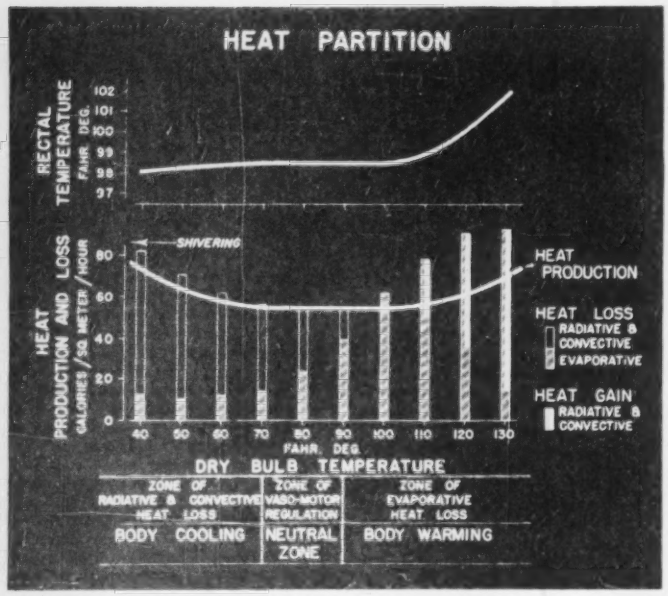


FIG. 1—Loss of heat by radiation, convection and evaporation depends on the physical properties of the environment

25 fpm. The hot dry environment would require and allow the loss of all the heat by evaporation. The hot moist environment would require but hinder the loss of all the heat by evaporation.

The blood flow under the above hot environments through the surface shell was increased six to eightfold, but the cardiac output, the pulse rate and the oxygen consumption were not increased until the rectal temperature rose, indicating a heat retention. With heat retention the enzymatic processes of the body were accelerated with increases in cardiac output, pulse rate and oxygen consumption.

The increased blood flow to the surface shell was not due to increased blood volume as shown by its direct measurement (Reference 8), but to a shunt of the blood from the central cylinder to the surface shell.

This in turn suggested the study of a rather important clinical problem. Does the exposure of patients with poor kidney function to hot environments reduce the blood flow to the kidney? If so, then such an environment would be deleterious. Byfield (Reference 9), during his residency in medicine, determined the blood flow through the kidney in comfortable (83.5 F dry bulb and 59.0 F wet bulb) and in hot moist conditions. This was done in patients with varying degrees of kidney failure. The blood flow was unchanged. The shunt which is established in hot conditions spares the kidney. Work by others (Reference 10) has shown that the blood flow through the kidney is geared to cardiac output. If this fails, then the kidney suffers. This contingency would doubtless not arise in exposure of patients to hot environments unless their circulations were unable to establish an increased peripheral blood flow.

Why People Faint

Before leaving this subject, another alteration in the circulation noted on the exposure of subjects to hot environments should be discussed. This is doubtless a corollary of the increased peripheral blood flow. If the subject was in a steady state in the supine position and was then allowed to stand upright, the blood pooled in the leg veins and not infrequently the venous return to the heart was insufficient to maintain the circulation (Reference 11). This was manifested by a series of changes — either slow pulse, severe drop in blood pressure and fainting; or rapid pulse, low pulse pressure and gradual stabilization of blood pressure with a somewhat less rapid pulse.

It was clear that this experiment demonstrated the mechanism of fainting which occurs when people are forced to stand relatively still on hot moist days. This is regarded as an early stage of heat exhaustion.

Sudden Change of Environment

More recently, we have been engaged in the study of the adjustments of the circulation of normal subjects and patients with heart disease when they were suddenly changed from a comfortable to a hot environment and when after a stay of 1 to 2 hr in a hot environment they were suddenly returned to the comfortable one (References 12, 13, 14).

Fig. 2 shows a subject returning from the hot environment to the comfortable room. It will be noted that he is wearing a union suit which carries 24 thermocouples and applies these securely to the surface of the body. The thermocouple leads are shown arising from the back of the suit and extending to the switchboard. Changes in temperature are followed by the potentiometer and readings can be taken at assigned intervals. The accessory apparatus required for these readings is shown to the right of the subject in the photograph.

The previous studies were on subjects in steady state. The one now to be reported concerns the dynamic state. Observations included changes in blood pressure, pulse rate, mean skin temperature, rectal temperature, evaporative water loss and comfort votes. The immediate changes were completed within 10 min and were followed by slower alterations which led to steady states. Outside of registration of alteration in comfort votes, all the other changes occurred without evidence of strain of the physiologic processes. Similar experiments were performed using cardiac patients as subjects. This group included patients with rheumatic valvular heart disease, hypertensive heart disease, and arteriosclerotic heart disease with and without angina. The patients selected were those regarded as having hearts competent for normal activity, which would in-

clude an ambulatory type of life not associated with work.

The observations on these cardiac patients included electrocardiographic tracings taken shortly after the exposure to the new environment. They showed no evidence of physiologic embarrassment following the sudden changes in the environments. This result might have been anticipated from our earlier exposure of normal subjects to hot environments, in which the cardiac output and heat production did not increase until there was heat retention. It was hoped that by the use of patients with damaged circulation a more sensitive biologic assay test would be introduced for the recognition of physiologic strain. Either strain does not exist under these experimental conditions or a still more sensitive test must be obtained, such as a patient with more severe circulatory deterioration. On the basis of information now available, it matters little, so far as the physiologic mechanism is concerned, whether the heat is eliminated by way of radiation and convection or by way of evaporation. The individual is less comfortable when using the evaporative mechanism (Zone of Evaporative Heat Loss, in Fig. 1) but there is no evidence to indicate that a physiologic strain has been induced.

Heat Retention or Loss With Body Cooling

When zones are reached in which heat is retained or body cooling results as indicated by changes in rectal temperature, Fig. 1, then extra heat production occurs as manifested by extra oxygen consumption. Clinically, heat retention is most commonly observed under several conditions, examples of which will be cited:

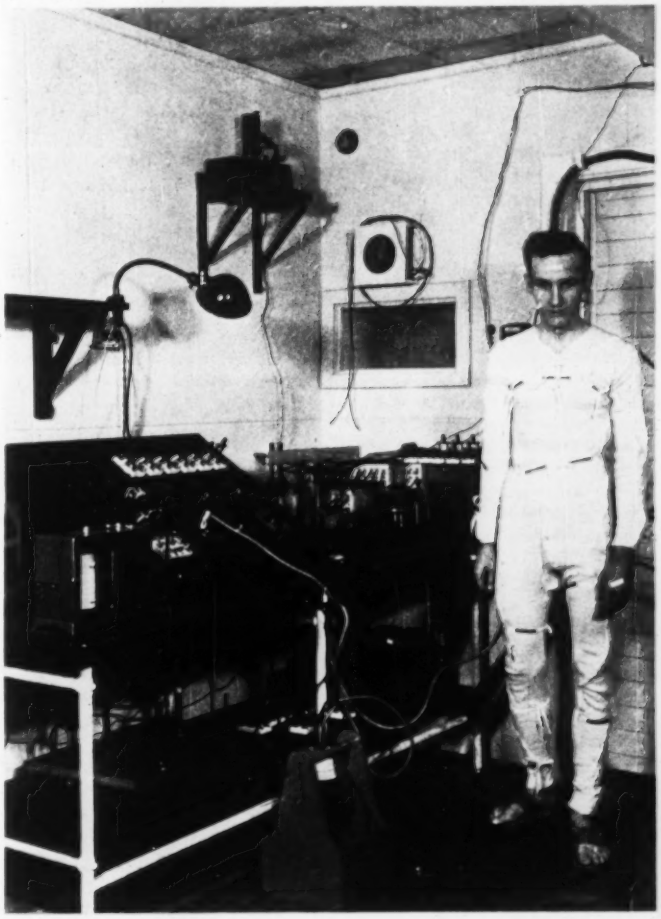
a) It may follow an operative procedure on a hot moist day during which the anesthetic has deranged the heat regulating mechanism. If this patient is untreated, he may pass rapidly into a condition of shock characteristic of a heat stroke and death results. It is obvious that he needs assistance in eliminating his heat. This can best be accomplished by placing him in a room with a dry bulb of 60 F and a relative humidity of 20 percent. If necessary, heat loss by convection can be facilitated with the use of a fan.

b) It may occur in a patient who has hyperthyroidism and extra production of heat and is exposed to a bout of hot humid weather in the summer. Such patients are said to be suffering from a thyroid crisis. The oxygen consumption may be increased to a value two times or more that of the normal subject. The patient is often short of water as the result of excessive sweating, vomiting and diarrhoea. The recovery is facilitated by the transfer of the patient to a cool dry environment and by supplying him with fluids intravenously which can be used for the evaporative loss of heat.

c) In patients with a failing heart, the lungs not uncommonly become filled with fluid due to stasis of blood which the heart is unable to move. The patient then loses his ability to eliminate the normal amount of heat through the evaporation of water to the air expired from the lungs. Added to this, the peripheral vessels frequently become constricted instead of dilated, with a resulting cold skin. The rectal temperature rises and more heat is produced. It is customary to see an increased number of cardiac deaths follow a bout of hot humid weather in the summer. The lives of not all of these patients can be saved. However, many can be saved and all of them can be made more comfortable if they are placed in a cool dry atmosphere.

Other than patients who have been exposed to prolonged cold or immersion in cold water, we rarely see

FIG. 2—Thermocouples fastened to the subject's union suit are applied securely to the surface of the body, enable accurate determination of temperatures



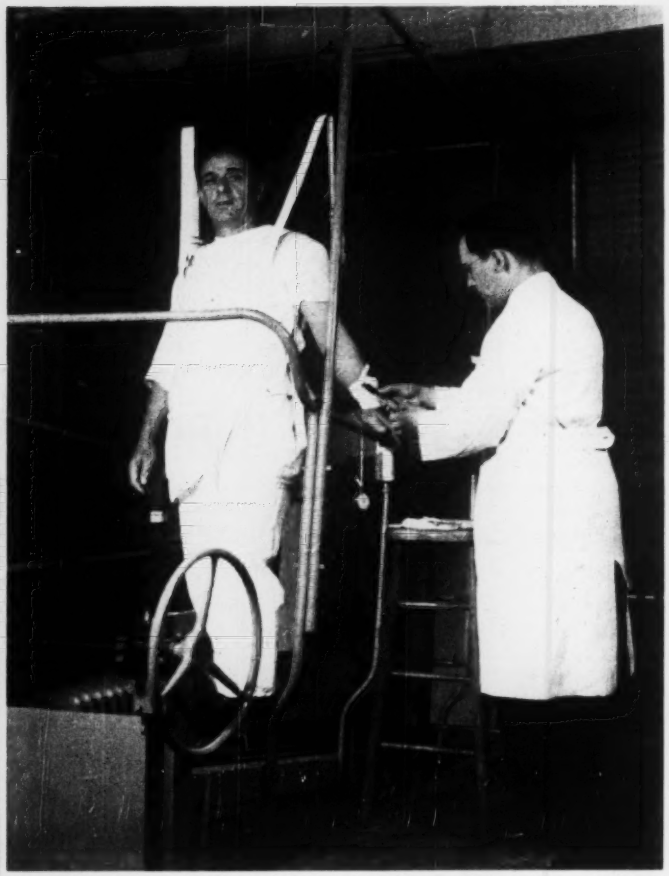


FIG. 3—Work experiments in summer would not be comparable to those in winter if this treadmill had not been set up in an air conditioned room

patients clinically with lowered rectal temperature and increased heat production. The indication in all of these cases is to assist them in retaining the heat which they are producing.

Stress of a Non-Uniform Environment

In the experiments which we have discussed, there were little or no air currents. The wall and air temperatures were the same. The dry bulb and the humidity were controlled. None of us lives in such a hypothetical environment. We are blown about by winds and are exposed to hot and cold surfaces. Up to the present time, we have no accepted method of integrating such an environment so that its effects on the human subject can be known or predicted.

Professor Fahnestock has already told you [see September HPAC] of our plans for the construction of a room for the study of radiation effects. He has pointed out the engineering problem of designing such a room. Certainly, we can know little of the effects of a non-uniform environment until it can be analyzed and can be referred to the human subject.

Almost all of us have at times been dissatisfied with an atmosphere conditioned for comfort even when an abundance of outside air has been circulated. We are impressed with its lack of freshness and its stimulating qualities. On the other hand, everyone enjoys a March day in Arizona providing he can stand in the sun and have the cool crisp air blow on his face. The analyses of these effects will depend on investigative work in the future.

The construction of an experimental room to produce such an environment has not been accomplished, although it is highly justified for the accumulation of basic information. The provision of such an environment in our homes and hospitals and other buildings may prove to be too expensive, even after the design has been agreed upon.

Changes in Barometric Pressure

In medicine, we are continually looking for ways and means by which we can measure and define objectively circulatory reserve. Levy (Reference 15) introduced the breathing of low concentrations of oxygen (10 percent) as a test of the efficiency of the circulation of the blood through the heart (coronary sufficiency). If the coronary vessels are small and do not carry their full quota of blood, then the electrical wave which accompanies the heart beat will have its pattern modified. While this test has some merits, it is not entirely satisfactory.

In the war, extensive studies were made of the reactions of normal subjects to high altitudes and low oxygen tensions. At present, we are planning to examine systematically patients with cardiac limitations when exposed to hypoxic environments induced in altitude chambers. We are finding that a rather complete study of the circulation as a whole must be made. It is not sufficient to base conclusions on electrocardiographic tracings alone. We are hoping that some objective information will be developed which can be correlated with cardiac function. In any event, we should be able to answer for any particular individual the specific question as to whether it is safe for him to be exposed for any given number of hours to an altitude of 7500 to 10,000 ft.

A second type of environmental stress in which the University of Illinois department of psychiatry is interested is that induced by increased oxygen tension (five atmospheres) to the point at which convulsions occur, "the hyper-oxic con-

[Concluded on page 104]

QUESTION of the Month

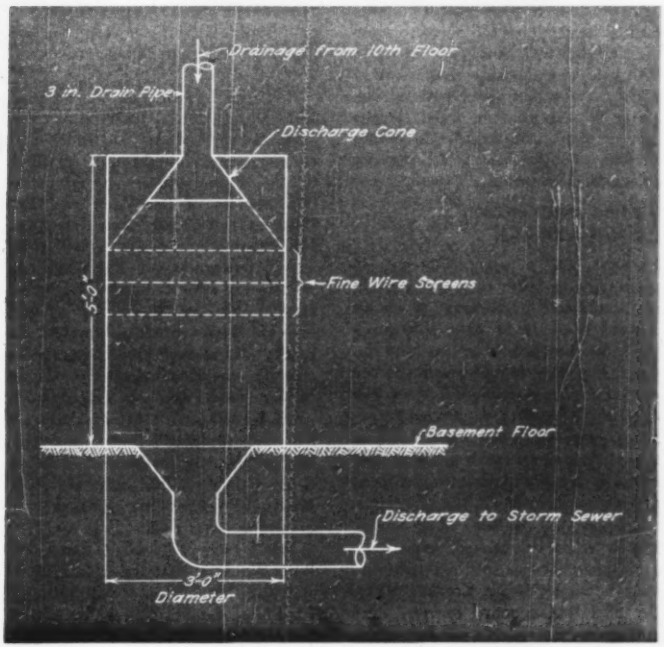
Questions on heating, piping and air conditioning asked by HPAC's readers are answered here each month. We hope you find these practical comments of regular interest, and will contribute either a question or an answer to a published question on occasion. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Illinois

SUGGEST WAYS TO SOLVE SHAMPOO PIPING PROBLEM

OUR MIXING KETTLES for shampoo are located on the 10th floor of one of our plant buildings, said "E. J. B." in his question published in October. After a production run, the mixing kettles are thoroughly cleaned and the 300 to 500 gal of water used in cleaning all of the kettles is run directly into a 3 in. drain pipe which runs straight down into the basement where it makes a sharp turn and flows into the storm sewer. As the cleaning water hits the turn in the drain pipe in the basement, the shampoo begins to foam and backs up through the drain pipe through the two floor drains on each floor. The foam has backed up through the floor drains as high as the fourth floor.

We realize (he said) that one solution would be to run a drain pipe from the 10th floor directly into the storm sewer without any floor drains on the lower floors. However, this would involve considerable expense, and we would welcome any other suggestions.

FOAM ELIMINATOR for drain discharge from shampoo process kettles, which should correct the difficulty according to suggestion from "M. H."



Install Foam Eliminator

IT APPEARS to me that the cause of the foaming is the increase in flow resistance, or friction, produced when the drain pipe hits the sharp turn before running into the storm sewer.

This sudden increase in flow resistance can be eliminated by running the sewer pipe into a properly dimensioned tank in the basement; that is, by simply providing capacitance or volume. The tank should also be provided with a series of screens in order to prevent any foam forming inside the tank from backing up, because a screen of proper mesh would destroy the bubble formations.

The accompanying sketch will, perhaps, give a better idea of the proposed arrangement, which should be inexpensive.—M. H.

Injecting Cold Water Might Help

TO SOLVE THE problem of soapsuds control, I suggest either installing a regular venturi fitting in place of the sharp bend in the basement or making one of the latter by boring it at the heel and inserting a venturi tube. The venturi should be connected to a city water line of ample size and pressure; or to a pump, for that matter. The water pressure should be applied at the time the suds are being drained.

While I trust that this will teach those suds a lesson and speed them on their way to the sewer, I nevertheless wish to state that the solution suggested is based on theory only. Only cold water should be used, of course.—W. O.

Vent the Drain Pipe

THE PHENOMENON of suds emerging from the floor drains is only possible with what in metropolitan areas is called an "illegal installation", it seems to me. Properly trapped floor drains should not let any gaseous

fluids pass through, and a properly vented drain pipe will not tend to blow through floor drains.

Further, most plumbing codes prohibit discharge of anything but rain water into storm sewers, for obvious reasons.

Trapping the already installed floor drains might prove quite expensive and create quite a disturbance.

Venting the 3 in. drain pipe (by extending it full size to 10 ft above the roof) is most likely to sufficiently remedy the situation. The jet effect of the water dropping in the 3 in. pipe some 100 ft is considerable and will force a lot of air—sucked in through the vent—down and this air will sweep the suds into the sewer.—S. R.

Use Anti-Foam Emulsion

REPLYING TO the Question of the Month regarding shampoo process suds, from experience gained by a similar problem, but on a smaller scale, we solved it by adding a minute amount of anti-foam emulsion. This solution is expensive but requires small quantities for highly effective results. The actual amount for use could be determined by the measure and trial method.

Another suggestion is to present the problem to a research laboratory, which might be able to suggest the least expensive counter-agent.—M. Mc.

Maybe Pipe's Too Big

ANSWERING THE shampoo suds piping problem, a bubblebath four stories high is quite a situation!

It is probably heresy, but I suspect that part of this trouble lies in too large a vertical drain pipe. In all likelihood the flow of water is insufficient to fill the pipe, allowing free fall of water from a height of 100 ft or so. It is not difficult to believe that even slightly sudsy water would develop a fine lather at the bottom.

The first step in the cure would be to reduce the size of the drain line in the lower half—say from 3 in. to 2 in. There should be ample head to carry this water vertically downward through this restricted pipe cross section.

The second step would then be to provide at the bottom in the basement a section of pipe where the high velocity water would be slowed down. Essentially, this would be a hollow cone laid on its side with the drain water entering at a tangent in the base and discharging out of the vertex to the storm sewer. Or, in lieu of this, a pipe coil that was conical in shape would serve to alter the direction of the water smoothly. Either of these arrangements should result in eliminating the turbulence of the 90 deg ell (presumed) at the foot of the stack and, in so doing, remove the mechanics of making suds.—S. Mc.

When Should We Use Our Own Men for Plant Piping Changes?

YOU ARE *invited to answer the following question, which has been submitted by a reader of* HPAC. *Suitable comment on the matter will be welcomed and—space permitting—will be published. Address your reply to the Editor, Heating Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.*

"We have some 40 maintenance men at our plant, eight of whom are pipefitters.

"On extensive piping changes in the plant—extension of piping services, major piping alterations, etc.—we usually call in one of two outside piping contractors, both of which have done considerable work for us.

"We of course must decide on any piping work, other than ordinary maintenance and minor changes and alterations, whether to have our own men do it or whether to call in these outside contractors. The main thing we have to decide is to what extent we can tie up our own men on new piping work or extensive changes, always remembering that ordinary maintenance must be kept up and the ever-present possibility of an emergency breakdown.

"I'd be most interested in any comment from other readers of HPAC on this question of when to use your own plant pipefitters on extensive piping alterations, and when to call in an outside contractor."—J.V.T.

WANTS DIMENSIONS OF PIPE FITTINGS

BECAUSE OF A great increase in piping design by our department, we have found it necessary to obtain a good book or booklet illustrating (1) the dimensions of various fittings according to sizes, and (2) the correct drafting symbols for pictorial diagrams according to current standard procedures. We can now find these by using several manufacturers' catalogs, but the material is scattered and not complete.—N.S.

YOU WILL FIND rather complete dimensional information in the Piping Handbook, by Sabin Crocker, member of HPAC's board of consulting and contributing editors. It is published by the McGraw-Hill Book Co., 330 W. 42nd St., New York 18. As to drafting symbols, the American Standards Association, 70 E. 45th St., New York 17, has a pamphlet on graphical symbols for use on drawings which includes many symbols for piping.

For complete information on pipe fitting dimensions, each type or pressure is covered in an individual standard, available through the office of the Manufacturers Standardization Society of the Valve and Fittings Industry, 420 Lexington Ave., New York 17, the American Standards Association, or the American Society of Mechanical Engineers, 29 W. 39th St., New York 18. A list of these standards and their prices, furnished by Lester W. Benoit, executive secretary of the MSS, follows:

SP-2-1946—MSS 150 and 300 Lb Bronze Flange and Flanged Fitting Standard	$0.45
SP-31-1950—MSS 300 Lb Malleable Iron Screw Fittings Standard	0.60
SP-43-1950—Stainless Steel Butt Welding Fittings	0.60
A10.2-1936—Brass Fittings for Flared Copper Tubes	0.45
B16b-1944—Cast Iron Pipe	

Flanges and Flanged Fittings, Class 250 ..... 0.55

B16b1-1931—Cast Iron Pipe Flanges and Flanged Fittings (for 800 Lb Hydraulic Pressure). 0.45

B16b2-1931—Cast Iron Pipe Flanges and Flanged Fittings (for Maximum WSP of 25 Lb) . 0.50

B16c-1939—Malleable Iron Screwed Fittings, 150 Lb 0.60

B16e-1939—Steel Pipe Flanges and Flanged Fittings including Supplement No. 1. B16e6-1949 (sold separately, B16e6-1949, $0.40) 1.85

B16.1-1948—Cast Iron Pipe Flanges and Flanged Fittings, Class 125 ..... 0.65

B16g-1929—Cast Iron Long Turn Sprinkler Fittings, including Addendum B16g1-1937 .... 0.60

B16.4-1949—Cast Iron Screwed Fittings, 125 and 250 Lb (Revision of B16d-1941). . 0.60

B16.9-1940—Steel Butt Welding Fittings 0.50

B16.11-1946—Steel Socket Welding Fittings 0.60

B16.12-1942—Cast Iron Screwed Drainage Fittings ... 0.55

B16.14-1949—Ferrous Plugs, Bushings and Locknuts with Pipe Threads 0.40

B16.15-1947—Brass or Bronze Screwed Fittings, 125 Lb 0.65

B16.16-1948—Cast Iron Flanges and Flanged Fittings for Refrigerant Piping, Class 300 ..... 0.45

B16.17-1949—Brass or Bronze Screwed Fittings, 250 Lb 0.35

B16.18-1950—Cast Brass Solder Joint Fittings (Revision of A10.3-1941) 0.75

—The Editors

PHYSICAL ENVIRONMENT—

[Concluded from page 100]

vulsions". Meduna (Reference 16), who is now a member of the department of psychiatry, introduced the anoxic type of convulsion as a treatment for schizophrenia and depressive states. These convulsions have been induced in a number of ways, more recently by means of electrical shocks, and such convulsions have proved to be valuable forms of treatment. The patient suffers some deterioration in memory and cerebral acuity for a period of time after their administration but recovery from these symptoms is usually complete. It would be desirable to determine whether the beneficial treatment of shock therapy could be secured without these side effects. At present, these studies are confined to animal experimentation.

Air Conditioning Needed for Metabolic Studies

Dr. H. H. Mitchell has discussed the subject of the uniform controlled physical environment as an experimental requirement for metabolic studies [October HPAC], but I wish to point out two types of experimental studies in which it has been found to be most helpful. During the last year, we were interested in the measurement of the lactate response of hospital patients to standard work loads. Such patients walked on the treadmill, Fig. 3, at a given rate for a specified time. The treadmill was set up in an air conditioned room and the patients were kept in an atmosphere conditioned for comfort. It can be readily seen that such work experiments performed in the summer would not have been comparable with similar experiments performed in the winter if the environment had not been controlled. The urinary excretion of lactate would doubtless have been different in the two environments.

Similarly, we are at present interested in the excretion of urinary sodium induced by the injection of certain steroids. It is obvious that if comparable results are to be obtained the loss of sodium through the sweat will have to be eliminated by preventing its formation.

Effect on Adrenal and Other Glands

Following Selye's (Reference 17) ideas as to the effects of stress on the organism mediated through the adrenal glands, investigators during the war studied the effects of hypoxia and cold on adrenal activity. Less attention has been given to the effect of heat on this mechanism. However, papers covering this phase of the subject are beginning to appear.

[This article is based on a paper presented at the 63rd annual convention of the Association of Land-Grant Colleges and Universities which is unavailable elsewhere in published form.]

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Sam Lewis' Page

INFORMAL COMMENT on heating, piping and air conditioning matters is given in this regular feature by Samuel R. Lewis, consulting mechanical engineer, and a member of HPAC's board of consulting and contributing editors.

* * *

WILLIS H. CARRIER has gone to join his early and long-continued associates, J. I. Lyle and William H. Driscoll. All three of these men were my friends during most of our lives.

My memory of "The Chief" harks back almost to our boyhoods and certainly it commenced when his advanced ideas about refrigerated air and control of its condition were germinating. The quality of his thinking was outstanding, and his grasp of higher mathematics was profound (where mine was not even superficial); yet in all our contacts through the years he always made me feel at ease while he expounded his inventions, and he never failed to impress me with his generosity and his modesty. Never did he seem to suggest conscious superiority, and never did I feel that he was restricting any information. He employed and helped to educate one of my sons, not only in his sort of engineering for refrigeration, but also in public service for kindness' sake.

Dr. Carrier's record will endure long and be remarkable on account of the quality of the associates that he chose.

I have always been proud (along with the many engineers of his staff) to call him "Chief," and I am proud now to acknowledge the obligation that I feel, personally, as well as for the engineering profession, of gratitude for his life here.

* * *

QUITE A FEW PROBLEMS IN BURNING WOOD

I HAVE HAD some recent experience in the burning of wood, and have found that one of its characteristics, unlike most other fuels, is that it heats most intensively the secondary surfaces in boilers or furnaces, while coal or oil or gas fuels are most effective where the heat absorbing surfaces can "see" the fire. Steel chimneys that serve wood burning boilers often are burned paint-free to their tops and the tubes and flues of wood burning furnaces usually require repairs long before the fireboxes play out.

Wood is said to be our natural resource of greatest value. As long as the sun shines and water flows and as long as our common sense persists, the natural resource of wood can be renewed.

In manufacturing processes, we continue to use vast quantities of wood. When we cut it and shape it, often wastefully, the saws and the lathes and the cut-out knots result in sawdust and shavings and splinters. Nearly all big saw mills have enormous drums, open on top, in which the wood waste—at considerable expense for labor and transportation—is burned, the heat going into the open air.

Woodworking plants in cities have a constant problem of sawdust disposal. We can collect the waste at the machines where it originates with hoods and fans, and we can blow the stuff long distances through ducts to centrifugal separators or cyclones and can store it in bins. We can burn it to make steam for power or for heating.

Here is where the trouble starts.

Usually we can purchase electric power more cheaply than we can make it from the steam. The woodworking factory must operate every day, in summer as well as in winter. It is reasonable to believe that with good sized, fire protected storage, we could store enough sawdust during the day to keep the buildings warm during the night in winter, but there will be no use for so much heat during the summer. In winter, however, the heating requirements are almost never balanced each day with the sawdust production.

I have had experience with one plant that makes highly specialized tools and instruments that involve very little wood waste. We burn the wood under the back end of the oil burning boiler and if the heat from the wood is not sufficient, the oil burner cuts in. When the heat from the wood is greater than what is needed, we have to waste the steam to the atmosphere through the safety valve. The boiler does not take kindly to the combined fuels, and the fireman does not take kindly to the job of shoveling the refuse into the boiler. But his labor became necessary when we discovered the apparent futility of mechanical delivery to the firebox from a storage bin.

Another case appeared where some of the steam resulting from burning wood refuse could be used the year around in dry kilns that operate in summer as well as in winter. A storage bin near the boilers was devised, capable of holding at least 24 hr production. This meant a smooth metal tank about 10 ft wide, 20 ft long and 12 ft deep. A screw conveyor in the bottom of the tank was to move the sawdust to the inlet of a centrifugal fan which, coordinated as to capacity, was to deliver the mixture of refuse and air into the furnace of a steam boiler. The boiler had adequate combustion chamber size and means for adequate automatic control. The plant went into production and trouble went into my soul.

The worm conveyor fills with sawdust, which like core sand in an iron foundry, packs into the worm and stays there. If, reluctantly, it does scour along the auger, the remaining sawdust builds an arch above the auger and stays arched and has to be hammered down so as to be delivered to the fan.

The fuel, even when delivered into the combustion chamber, refuses to burn in an even stream, but piles

up unevenly, and by no means all of it burns in suspension as was hoped. By skillful adjustment, we finally obtained effective combustion, but found that the steam cannot all be condensed in the heating system but must blow outdoors. Thus, the boiler must be fed intermittently with untreated cold makeup water. This water leaves heavy scale and mud in the boiler. So then we built a big steam unit heater out in the yard and operate an electric fan to force outside air around the steam coils, simply to condense the steam that comes from the surplus sawdust; all so that we may avoid loading up the boiler with scale and mud.

Now we have a sawdust burning plant, conceived under reasonable engineering principles, that does not work acceptably. I do not intend to give up this attempt to aid in the conservation of natural resources. The next stage will be to change the steel tank until its sides slope outward toward the bottom, so as to reduce the arching by eliminating skewbacks. I shall install a bin bottom paved all over with conveyors so that the sawdust will move to the conveyor fan. We will build an additional masonry combustion chamber exterior to the boiler furnace so as to permit better draft and combustion control and will install forced draft under pinhole grates. We just have to burn that sawdust!

WATER OFFICIALS DISCUSS AIR CONDITIONING

THE AMOUNT OF air conditioning being added each year has stabilized and can, in the future, be expected to follow the general business and building trend, according to R. A. Gonzalez, of the Airtemp Div. of Chrysler Corp., in speaking as a member of a panel discussing air conditioning demands at the annual convention of the Chesapeake section of the American Water Works Association in Wilmington, Dela., last month. Mr. Gonzalez emphasized, however, that this general observation did not apply to special uses of air conditioning and particularly not to room air conditioners, which have experienced remarkable expansion in sales volume in the past few years.

Mr. Gonzalez said that manufacturers of air conditioning equipment are among the nation's leaders in advocating and practicing water conservation. Where water supply shortages or water disposal difficulties are being experienced by municipalities, regulations on air conditioning installations to curb the use of water would generally make only a slight contribution to the solution of a community's overall water problem. The use and waste of water by all local commercial and industrial users requires careful survey and attention, he stated, if the municipality's water difficulties are to be overcome.

"Many factors contribute to municipal water supply and disposal problems and the factors vary in each locality", Mr. Gonzalez observed. "Usually", he said, "A primary reason is that the expansion of the community's water facilities has not kept pace with the growth of its commerce and industry."

"The more we study this problem in Dayton, Ohio, (which he cited as an example) the more evident it becomes that a larger water system is required by the combined industrial and population growth, and *that essentially the same increase would be required with or without the use of water for air conditioning*," he said. "Air conditioning and refrigeration do not stand convicted of increasing the summer peak demand in Dayton because the summer peak demand is actually proportionately less than it was 20 years ago."

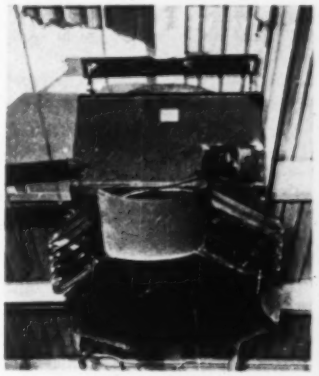
R. C. Willson of Hagerstown, Md., another member of the panel, outlined a constructive approach which his city had made to the water problem. Mr. Willson stated that Hagerstown had considered surcharges and other specific measures affecting users of water for air conditioning but had decided that the best approach was to increase water rates and to charge a sewer rate based on the amount of water used. The exception to this procedure is where air conditioning condenser water is being diverted to a storm sewer. In such instances a separate meter is permitted on this water and no sewer tax on it is charged.

In the general discussion following the panel presentations, the subject of water waste was reviewed. One speaker defined water waste as water that has escaped, is paid for, but does not fulfill any useful purpose for the buyer. Mr. Gonzalez expressed the view that there are few uses which actually consume water other than when it is used for drinking and ingredient purposes.

UNIT HEATER BOOSTS DRYING OVEN CAPACITY

IN THE PLANT of a large manufacturer of pharmaceuticals, production of a new drug necessitated a large increase in drying oven capacity.

The existing equipment consisted of seven drying racks in cabinet type dryers heated by steam coils. Maximum temperature was 160 F and air movement was very limited. The dryers were enclosed by masonry walls in a room 17 x 25 x 16 ft high to reduce heat in the adjacent manufacturing area.



TURBINE DRIVEN unit heater with revolving discharge outlets increases drying oven capacity for pharmaceutical manufacturer

A single turbine driven unit heater with four-way revolving discharge outlets was installed, suspended from the ceiling in the center of the room, thereby converting the entire room into one large dryer. The ambient temperature was raised from 160 to over 230 F but an automatic control was installed to keep a constant 210 F. Uniform temperatures are insured by the revolving discharge outlets and the air movement produced by the turbine driven fan, which is not affected by the high temperatures.

A production increase of over 500 percent was achieved, according to the L. J. Wing Mfg. Co.

DATA sheet

Solar Irradiation of Walls and Windows

Southeast and Southwest: October-April

By F. W. Hutchinson

HERE IS THE second group of four of a complete series of tables for use by heating, air conditioning or illuminating engineers in evaluating the instantaneous rate of direct solar irradiation on any vertical wall, at any time, in any place. The first group was for a south wall. Tables 5 through 8, presented herewith, are respectively for latitudes 30, 35, 40 and 45 deg and give vertical, H, and horizontal, B, components of the angle between the sun's rays and a normal to either a southeast-facing wall or a southwest-facing wall. Since the sun's positions for morning and afternoon are symmetrical with respect to solar noon, it follows that the same table is, in each case, applicable to either a southeast-facing wall during the hours from sunrise until the solar position is directly southwest, or to a southwest-facing wall from the time the sun is southeast until it sets.

In each of the tables the angle of incidence, i, is given as the number of degrees between the direction of the sun's rays and a normal to the surface. The cosine of this angle, cos i, is of great practical importance since it is numerically equal to the fraction of the vertical wall area that would be operative if this area were projected onto a plane normal to the sun's rays; thus the product $I_v \cos i$, given in the last column of each table, is the rate of direct solar irradiation per unit area of the vertical wall or window.

By interpolation between the irradiation rates taken from Table 1 (for a south wall) and Table 5 (for a southwest wall) the designer is able to determine the instantaneous irradiation rate for a vertical wall at latitude 30 deg which faces any direction between south and southwest or between south and southeast. Similarly, Tables 2 and 6 permit the same interpolation at 35 deg latitude, Tables 3 and 7 at 40 deg latitude, and Tables 4 and 8 at 45 deg latitude.

The two terms of greatest practical significance to the designer are the angle of incidence and the rate of irradiation. The latter term, by itself, is not of great importance since increase or decrement of either heating or cooling load depends not on the quantity of energy impinging on a surface, but on the rate at which energy is transmitted or absorbed; both transmission and absorption are functions of the angle of incidence and usually increase markedly as the angle of incidence decreases.

Values Do Not Include Sky Radiation

The irradiation rates given in the tables are for direct solar energy *only*, hence do not include sky radiation. Existing data on sky radiation are fragmentary and incomplete; such radiation is known to vary with the solar position, but the relationship is not well defined.

In comparing tables for a south wall with those for a southeast wall at the same latitude, it will be noticed that for some months there is one additional hour of morning sunshine on the southeast wall. This condition results from the fact that seasonally sunrise is north of east; hence, a wall facing south does not receive direct solar irradiation until the sun has been up sufficiently long to have moved south of east; in the same way a wall facing southwest will, during some months receive more hours of afternoon sunshine than one facing south since sunset will at times be north of west.

Tabular irradiation values are for clear days; during periods of partially obscured or intermittent sunshine the actual rate of irradiation will be less than the tabular values, but where solar effect is being considered with respect to cooling load the designer will obviously be primarily interested in clear weather data. For problems involving analysis of solar energy reception as an aid in meeting the heating load, the clear weather data are not conservative and must be adjusted by the designer in terms of experience and of weather bureau records for the locality in question. Lacking more specific information, it is suggested that the clear weather values be multiplied by the percent of maximum possible sunshine (available from weather records in each locality) and then reduced to 60 percent of this value as an arbitrary correction for reduced normal intensity during times of light cloudiness.

Using Data for Non-Vertical Surface

Under unusual circumstances of construction, it might become necessary to evaluate irradiation rates for a non-vertical wall. This cannot be done directly from the tables, but all necessary data for the requisite calculation are given in the tables and the calculation is very simple. Thus, for a wall facing south, but leaning 10 deg backward from the vertical, the vertical component of the true angle of incidence would be equal to the tabular value of H less 10 deg so the cosine of the true angle of incidence, cos i', would be equal to the product of the cosines of $H-10$ and B; the true rate of instantaneous irradiation would then be $I_v \cos i'$. For a wall leaning forward, the degrees departure from verticality would be *added* to the tabular value of H. The same method is obviously applicable to slanting roof surfaces or skylights.

The author is professor of mechanical engineering at the University of California, Berkeley. These tables are from a project on solar heating sponsored by the Libbey-Owens-Ford Glass Co. and carried on at Purdue University in cooperation with the Purdue Research Foundation: G. Stanley Meikle, research director of the foundation; Carl F. Boester, research housing consultant. Tables 1-4 were published in the July 1949 HPAC.

Table 5

Southeast or Southwest Wall — Latitude 30

Solar Time	Solar Altitude H	Azimuth A	B = A − 135	cos H	cos B	cos i	i	Normal Intensity In	In cos i
October									
SE SW									
7am, 5pm	8	107	−28	0.9903	0.8829	0.8743	29.04	147.7	129.10
8am, 4pm	18	117	−18	0.9511	0.9511	0.9046	25.25	245.2	221.80
9am, 3pm	29	127	−8	0.8746	0.9903	0.8661	29.99	279.0	241.66
10am, 2pm	39	141	6	0.7771	0.9945	0.7728	39.39	294.5	227.60
11am, 1pm	46	158	23	0.6947	0.9205	0.6595	50.25	302.2	195.20
12 noon	49	180	45	0.6561	0.7071	0.4639	62.36	305.1	141.50
1pm, 11am	46	202	67	0.6947	0.3907	0.2714	74.25	302.2	82.02
2pm, 10am	39	219	84	0.7771	0.1045	0.0812	85.34	294.5	23.92
3pm, 9am	—	233	—	—	—	—	—	—	—
November									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	18	123	−12	0.9744	0.9781	0.9531	17.62	211.0	201.10
9am, 3pm	29	133	−2	0.8755	0.9939	0.8079	24.28	271.6	246.60
10am, 2pm	39	147	12	0.8480	0.9781	0.8293	33.96	287.2	238.20
11am, 1pm	48	162	27	0.7880	0.8910	0.7021	45.40	297.0	208.50
12 noon	50	180	45	0.7660	0.7071	0.5416	57.21	299.0	161.90
1pm, 11am	48	198	63	0.7880	0.4540	0.3577	69.03	297.0	106.20
2pm, 10am	39	213	78	0.8480	0.2079	0.1763	79.83	287.2	50.65
3pm, 9am	—	227	—	—	—	—	—	—	—
December									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	11	125	−10	0.9816	0.9848	0.9667	14.83	191.2	184.80
9am, 3pm	21	136	1	0.9336	0.9998	0.9334	21.05	268.1	246.50
10am, 2pm	29	148	13	0.8746	0.9744	0.8522	31.55	280.8	242.70
11am, 1pm	35	163	28	0.8191	0.8829	0.7232	43.68	295.0	252.00
12 noon	37	180	45	0.7986	0.7071	0.5647	55.93	297.0	198.00
1pm, 11am	35	197	62	0.8191	0.4695	0.3846	67.38	295.0	113.70
2pm, 10am	29	212	77	0.8746	0.2249	0.1967	78.66	280.8	56.02
3pm, 9am	21	224	89	0.9336	0.0174	0.0162	89.07	268.1	4.28
January									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	11	125	−10	0.9816	0.9848	0.9667	14.83	191.2	184.80
9am, 3pm	21	136	1	0.9336	0.9998	0.9334	21.05	268.1	246.50
10am, 2pm	29	148	13	0.8746	0.9744	0.8522	31.55	280.8	242.70
11am, 1pm	35	163	28	0.8191	0.8829	0.7232	43.68	295.0	252.00
12 noon	37	180	45	0.7986	0.7071	0.5647	55.93	297.0	198.00
1pm, 11am	35	197	62	0.8191	0.4695	0.3846	67.38	295.0	113.70
2pm, 10am	29	212	77	0.8746	0.2249	0.1967	78.66	280.8	56.02
3pm, 9am	21	224	89	0.9336	0.0174	0.0162	89.07	268.1	4.28
February									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	18	123	−12	0.9744	0.9781	0.9531	17.62	216.0	205.90
9am, 3pm	29	133	−2	0.8755	0.9939	0.8079	24.28	278.0	252.40
10am, 2pm	39	147	12	0.8480	0.9781	0.8293	33.96	294.0	243.8
11am, 1pm	48	162	27	0.7880	0.8910	0.7021	45.40	304.0	213.4
12 noon	50	180	45	0.7660	0.7071	0.5416	57.21	306.0	165.7
1pm, 11am	48	198	63	0.7880	0.4540	0.3577	69.03	304.0	108.7
2pm, 10am	39	213	78	0.8480	0.2079	0.1763	79.83	294.0	51.84
3pm, 9am	—	227	—	—	—	—	—	—	—
March									
7am, 5pm	10	97	−38	0.9848	0.7880	0.7760	39.10	180.7	140.20
8am, 4pm	23	105	−30	0.9095	0.8660	0.7848	38.50	275.6	214.70
9am, 3pm	35	116	−19	0.8290	0.9455	0.7551	40.57	298.0	221.50
10am, 2pm	45	130	−5	0.7071	0.9962	0.6958	43.91	308.7	214.80
11am, 1pm	52	147	12	0.6157	0.9781	0.5928	47.05	312.6	197.50
12 noon	55	165	30	0.5902	0.7071	0.3535	69.30	313.6	111.10
1pm, 11am	52	208	73	0.5592	0.2924	0.1635	80.59	312.6	51.12
2pm, 10am	—	240	—	0.6561	—	—	—	—	—
3pm, 9am	—	253	—	—	—	—	—	—	—
April									
6am, 6pm	—	—	—	—	—	—	—	115.0	64.35
7am, 5pm	20	87	−48	0.9407	0.6691	0.6287	51.05	254.0	159.20
8am, 4pm	32	96	−39	0.8480	0.7771	0.6590	48.78	281.0	185.80
9am, 3pm	44	105	−30	0.7193	0.8660	0.6229	51.47	300.3	187.00
10am, 2pm	55	118	−17	0.5592	0.9563	0.5348	57.25	309.0	165.20
11am, 1pm	66	149	14	0.4067	0.9967	0.4051	66.10	314.7	127.50
12 noon	71	180	45	0.3255	0.7071	0.2302	76.69	316.7	72.90
1pm, 11am	66	220	85	0.4067	0.0872	0.0355	87.97	314.7	11.17
2pm, 10am	—	242	—	—	—	—	—	—	—
3pm, 9am	—	—	—	—	—	—	—	—	—

Table 6

Southeast or Southwest Wall — Latitude 35

Solar Time	Solar Altitude H	Azimuth A	B = A − 135	cos H	cos B	cos i	i	Normal Intensity In	In cos i
October									
SE SW									
7am, 5pm	8	108	−27	0.9903	0.8910	0.8823	28.08	146.7	129.4
8am, 4pm	17	118	−17	0.9563	0.9563	0.9145	23.87	259.4	218.9
9am, 3pm	27	128	−7	0.8910	0.9925	0.8843	27.85	275.2	245.3
10am, 2pm	36	143	8	0.8090	0.9903	0.8011	36.76	290.6	232.8
11am, 1pm	41	160	25	0.7547	0.9063	0.6840	46.84	297.4	203.4
12 noon	44	180	45	0.7193	0.7071	0.5086	58.43	300.4	152.7
1pm, 11am	41	200	65	0.7547	0.4226	0.3189	71.40	297.4	94.8
2pm, 10am	36	217	82	0.8090	0.1392	0.1126	83.53	290.6	32.7
3pm, 9am	—	—	—	—	—	—	—	—	—
November									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	11	124	−11	0.9816	0.9816	0.9645	15.53	190.5	183.5
9am, 3pm	21	135	0	0.9336	1.0000	0.9336	21.00	261.8	244.4
10am, 2pm	28	148	13	0.8829	0.9744	0.8603	30.65	280.4	241.2
11am, 1pm	32	163	28	0.8480	0.8829	0.7487	41.52	287.2	215.0
12 noon	33	180	45	0.8191	0.7071	0.5792	54.61	293.1	169.8
1pm, 11am	32	197	62	0.8480	0.4695	0.3981	66.54	287.2	114.3
2pm, 10am	28	212	77	0.8829	0.2249	0.1986	78.55	280.4	55.7
3pm, 9am	—	225	90	0.9336	—	—	—	—	—
December									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	10	126	9	0.9848	0.9877	0.9727	13.42	189.9	184.60
9am, 3pm	17	137	2	0.9563	0.9939	0.9505	18.10	245.1	244.60
10am, 2pm	24	149	14	0.9135	0.9703	0.8865	27.37	274.8	260.60
11am, 1pm	29	164	29	0.8746	0.8746	0.7646	40.36	285.7	249.90
12 noon	31	180	45	0.8572	0.7071	0.6061	53.09	288.6	204.10
1pm, 11am	29	196	61	0.8746	0.4848	0.4240	64.91	285.7	138.50
2pm, 10am	24	211	76	0.9135	0.2419	0.2210	77.23	274.8	60.50
3pm, 9am	17	225	88	0.9563	0.0349	0.0334	88.08	245.1	8.19
January									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	11	124	−11	0.9816	0.9816	0.9645	15.53	195.0	187.9
9am, 3pm	21	135	0	0.9336	1.0000	0.9336	21.00	268.0	250.2
10am, 2pm	28	148	13	0.8829	0.9744	0.8603	30.65	287.0	246.9
11am, 1pm	32	163	28	0.8480	0.8829	0.7487	41.52	294.0	220.1
12 noon	33	180	45	0.8191	0.7071	0.5792	54.61	300.0	173.8
1pm, 11am	32	197	62	0.8480	0.4695	0.3981	66.54	294.0	117.0
2pm, 10am	28	212	77	0.8829	0.2249	0.1986	78.55	287.0	57.0
3pm, 9am	—	225	90	0.9336	—	—	—	—	—
February									
7am, 5pm	8	108	−27	0.9903	0.8910	0.8823	28.08	150.2	132.5
8am, 4pm	17	118	−17	0.9563	0.9563	0.9145	23.87	245.1	224.1
9am, 3pm	27	128	−7	0.8910	0.9925	0.8843	27.85	281.7	249.2
10am, 2pm	36	143	8	0.8090	0.9903	0.8011	36.76	297.5	238.3
11am, 1pm	41	160	25	0.7547	0.9063	0.6840	46.84	304.4	208.2
12 noon	44	180	45	0.7193	0.7071	0.5086	58.43	307.4	156.3
1pm, 11am	41	200	65	0.7547	0.4226	0.3189	71.40	304.4	97.1
2pm, 10am	36	217	82	0.8090	0.1392	0.1126	83.53	297.5	33.5
3pm, 9am	—	—	—	—	—	—	—	—	—
March									
7am, 5pm	10	98	−37	0.9848	0.7986	0.7865	38.14	180.7	142.1
8am, 4pm	24	108	−27	0.9135	0.8910	0.8139	35.52	271.0	221.0
9am, 3pm	35	120	−15	0.8191	0.9659	0.7912	37.70	294.1	232.0
10am, 2pm	45	134	−1	0.7071	0.9998	0.7069	45.02	304.8	215.5
11am, 1pm	52	155	20	0.6157	0.9397	0.5786	54.65	310.7	179.8
12 noon	55	180	45	0.5902	0.7071	0.4054	66.71	312.6	126.6
1pm, 11am	52	205	70	0.6157	0.3420	0.2106	77.84	310.7	65.4
2pm, 10am	—	226	91	0.7071	—	—	—	—	—
3pm, 9am	—	240	—	0.8191	—	—	—	—	—
April									
6am, 6pm	—	80	−55	0.9035	0.5736	0.5603	55.30	133.2	76.4
7am, 5pm	20	90	−45	0.9407	0.7071	0.6645	48.36	254.0	180.2
8am, 4pm	32	98	−37	0.8572	0.7986	0.6845	46.80	281.0	225.1
9am, 3pm	42	108	−27	0.7431	0.8910	0.6621	48.51	298.3	265.8
10am, 2pm	51	122	−13	0.5878	0.9744	0.5727	55.06	308.0	300.1
11am, 1pm	62	146	11	0.4695	0.9816	0.4609	62.56	312.8	307.0
12 noon	66	180	45	0.4067	0.7071	0.2876	74.28	314.7	222.5
1pm, 11am	62	214	79	0.4695	0.1908	0.0896	84.86	312.8	59.7
2pm, 10am	—	238	—	0.5878	—	—	—	—	—
3pm, 9am	—	252	—	0.7431	—	—	—	—	—

Table 7

Southeast or Southwest Wall — Latitude 40°

Solar Time	Solar Altitude H	Azimuth A	B = $A-135$	cos H	cos B	cos i	i	Normal Intensity I_n	$I_n \cos i$
October									
SE SW									
7am, 5pm	8	108	—	0.9903	0.8910	0.8823	28.08	150.2	132.5
8am, 4pm	15	118	—	0.9659	0.9554	0.9237	22.55	226.9	209.6
9am, 3pm	23	131	—	0.9135	0.9975	0.9113	24.31	267.4	243.7
10am, 2pm	32	145	10	0.8480	0.9848	0.8551	33.37	284.8	243.5
11am, 1pm	42	162	27	0.7986	0.8910	0.7115	44.64	298.5	212.4
12 noon	49	180	45	0.7771	0.7071	0.5495	56.67	301.5	165.7
1pm, 11am	57	198	63	0.7986	0.4540	0.3626	68.74	298.5	108.2
2pm, 10am	52	215	80	0.8480	0.1736	0.1472	81.53	284.8	41.9
3pm, 9am	—	229	—	—	—	—	—	—	—
November									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	9	124	—	0.9877	0.9816	0.9695	14.19	166.0	160.9
9am, 3pm	16	139	—	0.9613	0.9908	0.9611	16.00	235.4	226.2
10am, 2pm	24	153	−18	0.9135	0.9705	0.8864	27.58	271.6	240.7
11am, 1pm	33	167	32	0.8829	0.8829	0.7795	38.70	280.4	218.6
12 noon	39	180	45	0.8746	0.7071	0.6184	51.80	282.5	174.6
1pm, 11am	38	193	62	0.8829	0.4695	0.4145	65.51	280.4	116.2
2pm, 10am	24	241	76	0.9135	0.2419	0.2210	77.23	271.6	60.0
3pm, 9am	16	224	89	0.9613	0.0174	0.0167	89.04	235.4	3.9
December									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	9	126	—	0.9877	0.9877	0.9755	12.71	168.0	163.9
9am, 3pm	14	138	17	0.9705	0.9986	0.9689	14.35	224.7	217.7
10am, 2pm	20	151	86	0.9397	0.9613	0.9033	25.40	260.2	235.0
11am, 1pm	28	165	30	0.9135	0.8660	0.7911	37.71	274.8	217.4
12 noon	34	180	45	0.9063	0.7071	0.6408	50.15	275.9	176.8
1pm, 11am	28	196	60	0.9135	0.5000	0.4567	62.85	274.8	125.5
2pm, 10am	20	209	74	0.9397	0.2750	0.2500	74.99	260.2	65.4
3pm, 9am	14	222	87	0.9705	0.0523	0.0507	87.09	224.7	11.4
January									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	9	124	—	0.9877	0.9816	0.9695	14.19	170.0	164.8
9am, 3pm	16	139	—	0.9613	0.9908	0.9611	16.00	241.0	231.6
10am, 2pm	24	153	18	0.9135	0.9705	0.8864	27.58	278.0	246.4
11am, 1pm	33	167	32	0.8829	0.8829	0.7795	38.70	287.0	223.7
12 noon	39	180	45	0.8746	0.7071	0.6184	51.80	289.0	178.7
1pm, 11am	33	193	62	0.8829	0.4695	0.4145	65.51	287.0	119.0
2pm, 10am	24	241	76	0.9135	0.2419	0.2210	77.23	278.0	61.4
3pm, 9am	16	224	89	0.9613	0.0174	0.0167	89.04	241.0	4.0
February									
7am, 5pm	8	108	—	0.9903	0.8910	0.8823	28.08	150.2	132.5
8am, 4pm	15	118	—	0.9659	0.9563	0.9237	22.55	232.3	214.6
9am, 3pm	23	131	—	0.9135	0.9976	0.9113	24.31	275.8	249.5
10am, 2pm	32	145	10	0.8480	0.9848	0.8551	33.37	291.6	243.5
11am, 1pm	42	162	27	0.7986	0.8910	0.7115	44.64	298.5	212.4
12 noon	49	180	45	0.7771	0.7071	0.5495	56.67	301.5	165.7
1pm, 11am	42	198	63	0.7986	0.4540	0.3626	68.74	298.5	108.2
2pm, 10am	32	215	80	0.8480	0.1736	0.1472	81.53	291.6	42.9
3pm, 9am	23	229	—	—	—	—	—	—	—
March									
7am, 5pm	9	98	—	0.9877	0.7986	0.7888	38.33	166.1	131.0
8am, 4pm	22	110	—	0.9272	0.9063	0.8405	32.83	264.8	222.5
9am, 3pm	32	125	—	0.8480	0.9781	0.8294	33.96	288.2	239.0
10am, 2pm	41	137	2	0.7547	0.9994	0.7542	41.03	300.9	226.9
11am, 1pm	47	157	22	0.6820	0.9272	0.6324	50.78	306.8	190.9
12 noon	50	180	45	0.6428	0.7071	0.4545	62.97	308.7	140.3
1pm, 11am	47	203	68	0.6820	0.5736	0.3555	75.20	306.8	78.4
2pm, 10am	41	225	88	0.7547	0.0349	0.2650	88.51	300.9	7.9
3pm, 9am	32	247	—	—	—	—	—	—	—
April									
7am, 6pm	8	81	—	0.9903	0.5878	0.5821	54.40	146.7	85.4
7am, 5pm	10	91	—	0.9455	0.7193	0.6801	47.08	250.1	170.1
8am, 4pm	30	101	—	0.8660	0.8290	0.7170	44.12	281.0	201.7
9am, 3pm	41	112	—	0.7547	0.9205	0.6947	46.00	297.4	206.6
10am, 2pm	51	128	17	0.6293	0.9925	0.6246	51.35	306.1	191.2
11am, 1pm	59	152	17	0.5150	0.9563	0.4928	60.49	310.0	153.1
12 noon	61	180	45	0.4848	0.7071	0.3428	69.95	311.8	106.9
1pm, 11am	59	208	73	0.5150	0.2924	0.1506	81.34	310.9	46.8
2pm, 10am	51	232	—	—	—	—	—	—	—
3pm, 9am	41	248	—	—	—	—	—	—	—

Table 8

Southeast or Southwest Wall — Latitude 45°

Solar Time	Solar Altitude H	Azimuth A	B = $A-135$	cos H	cos B	cos i	i	Normal Intensity I_n	$I_n \cos i$
October									
SE SW									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	13	119	−16	0.9744	0.9613	0.9367	20.50	208.5	195.3
9am, 3pm	22	132	−3	0.9272	0.9986	0.9259	22.20	261.6	242.2
10am, 2pm	27	146	11	0.8910	0.9816	0.8746	29.00	275.2	240.7
11am, 1pm	32	163	28	0.8480	0.8829	0.7487	41.52	284.8	213.2
12 noon	34	180	45	0.8290	0.7071	0.5862	54.11	287.7	168.6
1pm, 11am	32	197	62	0.8480	0.4695	0.3981	66.54	284.8	113.4
2pm, 10am	27	214	79	0.8910	0.1908	0.1700	80.21	275.2	46.8
3pm, 9am	—	228	—	—	—	—	—	—	—
November									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	8	125	−10	0.9903	0.9848	0.9742	13.05	148.5	144.70
9am, 3pm	13	137	−2	0.9744	0.9904	0.9738	13.15	211.0	205.50
10am, 2pm	17	150	15	0.9563	0.9659	0.9237	22.55	245.2	226.50
11am, 1pm	22	164	29	0.9272	0.8746	0.8109	35.82	264.8	214.70
12 noon	24	180	45	0.9135	0.7071	0.6459	49.77	271.6	175.40
1pm, 11am	22	196	61	0.9272	0.4848	0.4495	63.29	264.8	119.03
2pm, 10am	17	210	75	0.9563	0.2588	0.2475	75.67	245.2	60.70
3pm, 9am	13	223	88	0.9744	0.0349	0.0340	88.05	211.0	7.17
December									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	9	127	−8	0.9877	0.9903	0.9781	12.01	168.0	164.3
9am, 3pm	11	139	4	0.9816	0.9976	0.9792	11.70	192.7	188.7
10am, 2pm	15	152	17	0.9744	0.9563	0.9318	21.28	215.5	200.8
11am, 1pm	18	165	30	0.9511	0.8660	0.8236	34.55	251.1	206.8
12 noon	22	180	45	0.9272	0.7071	0.6556	49.05	267.9	175.6
1pm, 11am	18	195	60	0.9511	0.5000	0.4755	61.61	251.1	119.4
2pm, 10am	15	208	73	0.9744	0.2924	0.2849	73.44	215.5	61.4
3pm, 9am	11	221	86	0.9816	0.0698	0.0685	86.07	192.7	13.2
January									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	8	125	−10	0.9903	0.9848	0.9742	13.05	152.0	148.10
9am, 3pm	13	137	−2	0.9744	0.9994	0.9738	13.15	216.0	210.30
10am, 2pm	17	150	15	0.9563	0.9659	0.9237	22.55	251.0	231.80
11am, 1pm	22	164	29	0.9272	0.8746	0.8109	35.82	271.0	219.70
12 noon	24	180	45	0.9135	0.7071	0.6459	49.77	278.0	179.60
1pm, 11am	22	196	61	0.9272	0.4848	0.4495	63.29	271.0	121.80
2pm, 10am	17	210	75	0.9563	0.2588	0.2475	75.67	251.0	62.12
3pm, 9am	13	223	88	0.9744	0.0349	0.0340	88.05	216.0	7.34
February									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	13	110	−16	0.9744	0.9613	0.9367	20.50	213.5	200.00
9am, 3pm	22	132	−3	0.9272	0.9986	0.9259	22.20	267.9	248.00
10am, 2pm	27	146	11	0.8910	0.9816	0.8746	29.00	281.7	246.50
11am, 1pm	32	163	28	0.8480	0.8829	0.7487	41.52	291.6	218.30
12 noon	34	180	45	0.8290	0.7071	0.5862	54.11	294.6	172.70
1pm, 11am	32	197	62	0.8480	0.4695	0.3981	66.54	291.6	116.10
2pm, 10am	27	214	79	0.8910	0.1908	0.1700	80.21	281.7	47.89
3pm, 9am	—	228	—	—	—	—	—	—	—
March									
7am, 5pm	8	101	−34	0.9903	0.8290	0.8209	34.82	148.5	121.9
8am, 4pm	22	111	−24	0.9307	0.9135	0.8584	30.86	264.8	227.3
9am, 3pm	29	124	−11	0.8746	0.9816	0.8585	30.86	282.5	242.5
10am, 2pm	38	140	−5	0.7880	0.9962	0.7850	38.27	297.0	233.1
11am, 1pm	44	160	25	0.7193	0.9063	0.6519	49.51	302.9	197.5
12 noon	45	180	45	0.7071	0.7071	0.5000	60.00	303.8	152.4
1pm, 11am	44	200	65	0.7193	0.4226	0.3040	72.30	302.9	92.1
2pm, 10am	—	220	85	0.7880	0.0872	0.0687	86.06	—	—
3pm, 9am	—	236	—	—	—	—	—	—	—
April									
6am, 6pm	8	82	−53	0.9903	0.6018	0.5960	53.42	146.7	87.40
7am, 5pm	18	93	−42	0.9511	0.7431	0.7068	45.02	245.2	173.30
8am, 4pm	30	103	−32	0.8660	0.8480	0.7345	42.73	281.0	206.40
9am, 3pm	40	117	−18	0.7771	0.9511	0.7391	42.34	294.5	217.70
10am, 2pm	47	133	−2	0.6820	0.9994	0.6816	47.03	303.2	206.70
11am, 1pm	54	154	19	0.5878	0.9455	0.5558	56.23	308.0	171.20
12 noon	56	180	45	0.5592	0.7071	0.3954	66.71	309.0	122.20
1pm, 11am	54	206	71	0.5878	0.3256	0.1914	78.96	308.0	58.95
2pm, 10am	47	227	—	—	—	—	—	—	—
3pm, 9am	—	245	—	—	—	—	—	—	—

Heating, Piping & Air Conditioning

THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

JOURNAL *SECTION*

Water-Vapor Permeability of Building Papers and Other Sheet Materials

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SUMMARY—The water vapor permeability of 100 building papers and other sheet materials was determined according to *Tentative Standard Procedure* C214-47T prepared by Committee C-16 of the *American Society for Testing Materials*. Both the dry and wet methods were used. Generally, the wet method yields values somewhat higher than those found by the dry method under the same conditions of temperature, air velocity, and vapor pressure difference through the samples, but the ratio between them was not even approximately constant.

The test chamber was equipped with a sensitive thermostat and wood-element hygrostat that held both dry and wet bulb temperatures within very small variations. Pans were weighed in an enclosure in the chamber to maintain test chamber conditions during weighing and to exclude air currents. Deviations from the *ASTM Tentative Standard Procedure* C214-47T in regard to materials, methods, and techniques and the resulting advantages are explained. A special method of sealing specimens over wet pans was developed and is described. The very large range of permeability values presented in the tables indicates that the tests included materials of both very low and very high permeability. They also indicate the magnitude of variations between different samples of the same material.

SEVERAL methods are currently in use for measuring the water-vapor permeability of building materials. The work described herein was carried on during the summer of 1947 in cooperation with the Division of Standardized Building Codes and Materials, *Housing and Home Finance Agency*, to evaluate the water-vapor permeability of many building papers and other sheet materials according to *Tentative Standard Procedure* C214-47T, *American Society for Testing Materials*, and minutes of *ASTM* Committee C16. The procedure and minutes included a dry and a wet method, both of which were used in the present work. The materials tested were largely paper-base compositions treated in various ways to make them resistant to the passage of water vapor.

Materials for the tests were furnished by the manufacturers. Sufficient quantities of most materials were received to prepare several wet and dry pans. A large percentage of the papers and sheet materials were treated with asphalt, some with tar, a few with wax and asphalt, and some with an aluminum-pigmented coating or aluminum foil.

Test Apparatus

Chambers

Two chambers ordinarily used for drying or conditioning wood were prepared for the permeability tests.

A highly sensitive thermostat located midway between the fans controlled the heat input through the resistance heating coils. One set of heaters was placed opposite each of the two fans. Nearly constant cooling was provided by circulating city water through the cooling pipes. A wood-element hygrostat suspended from the ceiling maintained a nearly constant relative humidity by controlling the quantity of steam permitted to enter the chamber through small holes at intervals along the length of the humidifier pipe. Air was circulated by two 24-in. fans, each rotating at 1140 rpm and having a capacity of 5500 cfm free delivery.

The air circulation is indicated by the curved arrows of Fig. 1. The fans forced the air into the space in front of the racks and through the

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Table 1—Water-Vapor Permeability of Various Building Materials Determined by the Dry and Wet Methods

Sample No.	Description of material[1] and remarks	Weight per roll of 500 square feet	Dry method: Number of specimens	Dry method: Water-vapor transmission: Mean	Dry method: Water-vapor transmission: Coefficient of variation	Wet method: Number of specimens	Wet method: Water-vapor transmission[2]: Mean	Wet method: Water-vapor transmission[2]: Coefficient of variation
		Pounds		Grains per sq. ft. per hr. per in. Hg.	Percent		Grains per sq. ft. per hr. per in. Hg.	Percent
	Single sheets sheathing and roofing products							
	Saturated with tar (tar felt)							
101	15-pound tar felt	70	3	1.560	35.2	3	9.355	2.9
1201	30.....do	139	6	33.304	16.9	3	36.323	4.6
1204	15.....do	70	3	4.055	1.7	3	18.234	8.5
	Saturated with asphalt (asphalt felt)							
102	15-pound asphalt felt	70	3	.971	23.6	3	5.564	2.4
103	30.....do	139	3	.498	7.8	3	3.465	8.2
1205	15.....do.....(Asbestos base)	70	6	.774	74.0	3	2.815	6.6
1206	15.....do	70	3	2.007	21.0	3	8.158	4.9
1207	30.....do	139	3	3.022	2.8	3	6.394	5.7
1212	Asphalt-saturated sheathing paper	22	6	3.267	21.2	3	20.231	7.5
1800	15-pound asphalt felt	70	3	1.207	2.7	3	5.661	8.5
1801	30.....do	139	6	.560	45.6	3	3.447	1.3
	Saturated and coated with asphalt (sheathing paper)							
400	Coated sheathing paper	43	5	.287	47.1	5	.566	19.9
1805	.....do	50	2	.146	8.9	3	1.046	13.8
1804	Coated sheathing paper, filler in coating	88	2	.156	26.8	3	.252	17.5
	Saturated and coated felts (roll roofing)							
100	Heavy saturated and coated felt	326	3	.052	34.5	3	.239	17.8
104	Heavy saturated and coated felt, one side glossy.....(Glossy side up)	200	2	.032	1.2	4	.143	9.7
	.....do.....(Glossy side down)		2	.033	10.6			
105	Heavy saturated and coated felt	260	3	.035	3.6	3	.158	13.3
106	Heavy saturated and coated felt, mineral filler in coating	290	3	.030	33.3	3	.130	14.8
1200	55-pound smooth roll roofing, mineral surface	255	2	.030	.0	3	.581	51.6
1202	45-pound smooth roll roofing, mineral filler in coating	210	3	.027	13.1	3	.366	47.1
1203	60-pound smooth roll roofing, asbestos base	270	3	.080	39.7	3	.293	44.9
1208	65-pound smooth roll roofing, mineral filler in coating	300	3	.027	21.6	3	.376	22.6
1802	65.....do	300	3	.017	.0	3	.122	69.1
1803	55.....do	255	3	.081	75.2	3	.180	71.2
	Duplex or laminated products. Untreated kraft asphalt laminae not reinforced							
602	20-20-20	11	2	.805	3.8	2	1.976	3.5
605	30-60-30	21	5	.527	16.3	5	1.660	33.4
609	30-30-30	16	8	.447	4.8	3	.768	4.8
1103	30-100-30	27	2	.280	.0	1	.451	
1113	60-30-60.....(Insufficient material for wet pan test)	25	2	.850	1.6			
1116	60-60-60.....do	30	2	.300	1.3			
1211	60-80-60	35	3	.330	11.3	3	.743	5.3
1215	30-30-30	16	3	.846	13.4	3	2.917	1.8
1600	30-30-30	15	3	1.081	.7	3	2.317	11.9
1601	30-50-30	18				2	2.454	45.0
1602	60-60-60	30				2	2.398	37.7
1603	30-40-30	17	3	.711	6.1	5	1.752	30.3
1619	50-60-50	27	3	.526	7.7	3	.864	22.4
1700	(No description submitted)	43	3	.227	7.6	3	.876	15.6
1704	.....do	15	3	.703	11.0	6	1.585	21.4
1706	.....do	22	6	.223	14.7	3	.422	13.3
1709	.....do	30	6	.504	34.2	3	1.349	29.7
	Duplex or laminated products, untreated, creped							
603	30-30-30	14	5	1.812	9.5	7	3.939	9.1
610	20-80-20	21	8	2.145	27.7	5	5.845	16.0
1100	30-60-30	28	2	.345	11.5	1	.925	
1101	30-30-30	15	2	.583	.2	1	1.547	
1104	30-30-30	15	2	.657	7.0	1	1.702	
1108	40-75-40	26	2	.840	10.7	1	2.291	
1110	30-30-60.....(Insufficient material for wet pan test)	20	2	.884	20.1			
1111	30-60-30.....do	20	2	.504	24.5			
1213	40-55-40	23	6	2.159	53.9	6	6.184	39.9
1620	50-130-50	38	5	.205	26.4	3	.908	15.5
	Duplex or laminated products, untreated, reinforced							
1102	30-30-30	15	2	.395	5.2	1	2.194	
1105	30-85-30	24	2	.654	8.8	1	2.339	
1107	20-20-20	10	2	1.241	9.7	1	1.660	
1108	20-20-20	10				1	1.491	
1109	(No description submitted)					1	1.006	
1112	30-30-30.....(Insufficient material for wet pan test)	15	2	.472	19.1			
1114	40-95-40.....do	30	2	.354	.0			
1115	30-80-30.....do	24	2	.296	15.8			

racks over the permeability test pans to the rear of the chamber. In the space behind the racks the air was conditioned with respect to temperature and relative humidity before continuing through the fans.

Fig. 2 is a rear view of the chamber, showing some of the control mechanism and the recorder on which dry and wet bulb temperatures were recorded continuously. During the on-off cycles of heating and humidifying, the dry and wet bulb temperatures passed through a range of approximately 0.3 deg. The atmospheric conditions were maintained at 90 F and 50 percent relative humidity.

Table 1 (Cont.)—Water-Vapor Permeability of Various Building Materials Determined by the Dry and Wet Methods

Sample No.	Description of material[1] and remarks	Dry method: Weight per roll of 500 square feet	Dry method: Number of specimens	Dry method: Water-vapor transmission[2]: Mean	Dry method: Water-vapor transmission[2]: Coefficient of variation[3]	Wet method: Number of specimens	Wet method: Water-vapor transmission[2]: Mean	Wet method: Water-vapor transmission[2]: Coefficient of variation[3]
		Pounds		Grains per sq. ft. per hr. per in. Hg.	Percent		Grains per sq. ft. per hr. per in. Hg.	Percent
	Duplex or laminated products, untreated, reinforced (continued)							
1209	30-120-30	30	3	0.389	11.2	3	1.119	10.1
1210	45-90-45	30	3	.362	14.7	3	2.423	17.4
1501	30-120-30	34	3	.346	10.3	3	1.839	5.6
1606	30-90-30	25				2	1.612	21.5
1607	30-120-30	33				2	1.430	7.4
1608	60-150-60 Creped one side (Creped side up)	45	2	.274	4.0	3	1.257	5.4
	do. (Creped side down)		2	.399	9.2			
1609	60-180-60 Creped	50				2	1.197	3.3
1610	40-180-40...do	43				2	.660	6.1
1612	30-120-30...do	30	3	.241	2.1	3	.835	6.5
	Treated duplex or laminated products, one or more sheets saturated with asphalt							
1214	60-30-60 Saturated one side (Saturated side up)	30	2	1.037	3.4	4	6.369	38.7
	do. (Saturated side down)		2	.935	20.6	4	5.741	12.9
1502	Saturated two sides, reinforced	39	6	.258	33.1	6	1.067	28.0
1604	50-65-50 Saturated one side	28				2	1.864	20.8
1611	30-100-30 Saturated two sides, reinforced	27	3	.279	7.8	3	1.024	6.4
	Duplex sheets with reflective coating - asphalt laminae							
1300	Coated two sides	15	3	99.210	13.5	5	76.615	5.1
1301	Coated two sides, reinforced	35	3	.226	8.1	3	.623	37.1
1302	do.	47	6	.349	24.6	3	1.232	6.0
1203	do.	40	3	.304	11.5	3	1.377	12.2
1614	20-80-20 Aluminum foil two sides	28	3	.230	88.7	3	.041	72.8
1705	Aluminum foil one side (Aluminum side up)	43	2	.002	141.5	2	.176	88.9
	do. (Aluminum side down)		1	.001	.0	2	.163	64.6
2000	do. (Aluminum side up)	49	2	.107	134.0	2	.331	24.5
	do. (Aluminum side down)		2	.012	126.5	2	.248	10.8
	Duplex sheets with miscellaneous treatments and coatings							
1500	Shrinkproof treatment both sides, reinforced	35	3	.294	6.4	6	2.031	14.3
1605	50-65-50 Abrasion-resistant treatment one side	28				2	4.873	19.0
1613	Aluminum foil - 20-pound asphalt-30-pound kraft (Aluminum side up)	18	2	.000	.0	2	.027	40.6
	do. (Aluminum side down)		2	.002	22.8	2	.228	41.1
	Insulation back-up paper							
1000	Fire-resistant treatment one side (Treated side up)	48	2	.253	17.3	8	1.774	37.5
	do. (Treated side down)		2	.116	18.0	8	3.612	30.3
1004	Paraffin-impregnated one side, asphalt side ribbed (Asphalt side up)	18	3	.133	1.2	2	2.497	5.9
	do. (Asphalt side down)		4	.237	52.2	2	2.835	2.2
1616	Single-infused, ribbed (Asphalt side up)	18	2	.232	25.7	2	.589	4.6
	do. (Asphalt side down)		2	.162	11.1	2	.446	8.6
1617	Single-infused (Asphalt side up)	12	4	.443	44.6	2	1.801	8.1
	do. (Asphalt side down)		4	.583	81.3	2	.586	76.4
1806	Asphalt-saturated, one side glossy (Glossy side up)	21	2	.327	35.6	2	4.234	94.2
	do. (Glossy side down)		2	.377	38.5	2	.583	5.2
	Single sheet - kraft - double infused							
606	Saturated kraft - 70 percent kraft - 30 percent asphalt	16	5	30.764	19.9	5	41.926	7.1
607	Saturated kraft - 66-2/3 percent kraft - 33-1/3 percent asphalt	11	5	6.197	5.2	5	9.755	8.1
608	Saturated paper, creped - 80 percent kraft - 20 percent asphalt	9	3	99.323	5.2	5	67.807	4.6
1621	90-pound kraft saturated to 115-pound	19	3	99.345	1.3	3	66.997	2.2
1701	Asphalt-saturated kraft	18	6	3.612	63.5	6	9.429	35.2
1702	do.	23	5	7.987	34.2	6	12.235	22.8
1703	do.	11	6	7.447	17.3	3	11.916	9.6
1707	do.	15	3	2.469	6.6	3	7.044	24.1
1708	do.	22	6	.524	20.2	3	.976	6.9
1710	do.	23	3	11.656	10.8	3	16.515	4.7
	Miscellaneous pulp and paper products							
1001	Single-sheet vapor barrier with fire-resistant coating two sides	48	9	.189	73.3	6	29.383	9.2
1805	0.00035-inch-thick aluminum foil on 20-pound bond paper (Aluminum side up)	16	2	.005	93.1	2	4.370	1.4
	do. (Aluminum side down)		2	.003	141.4	2	1.072	11.7
2001	Corrugated asbestos on aluminum-foil-backed paper (Aluminum side up)	49				2	.984	13.2
	do. (Aluminum side down)					2	1.684	10.2

[1] Descriptions furnished by manufacturers.

[2] Values obtained at 90° F. and 50 percent relative humidity - vapor pressure = 0.711 inch mercury - adjusted to 1 inch mercury by dividing by 0.711. Vapor pressure at 90° F. = 1.4219 inches of mercury (ASHVE Guide for 1947).

[3] The standard deviation divided by the mean times 100. This value is a measure of variability resulting from nonuniformities in material and variations in test conditions.

Racks

Each chamber was equipped with racks (Fig. 1) to support the pans and permit a free movement of air over the test specimens. The racks were 26 in. deep, so that two pans used in the wet method could be placed in each opening, one on the side of entering air and the other on the side of leaving air. Six openings in each rack (Fig. 3) contained inserts, each of which held 10 dry pans. The racks were designed to provide an opening of 3½ in. above both the large and small

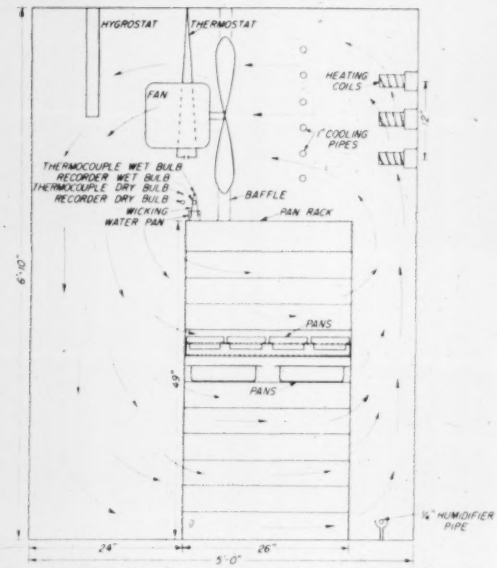

Fig. 1—Schematic cross section of vapor-permeability test chamber

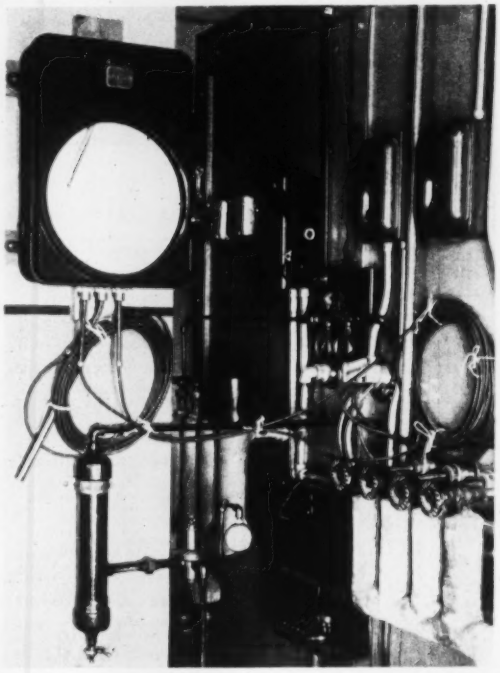

Fig. 2—Rear view of vapor-permeability test chamber showing part of the control mechanism and the wet and dry bulb temperature recorder

pans. With this configuration, 120 dry pans and 108 wet pans could be placed in each chamber.

Pans

The aluminum pans used in the dry method and the copper pans used in the wet method are shown in Fig. 4. The aluminum pans employed in the dry method were 15/32 in. deep and had an exposed area of 20.6 sq in. The copper pans were 2 in. deep and had a ¾-in. horizontal flange in which to seal the specimens. The exposed area of the specimens was 100 sq in.

Anemometer

Velocities were measured with a temperature-compensated hot-wire anemometer. Calibration of the meter was checked by comparison with Pitot tube measurements in a wind tunnel at the College of Engineering, University of Wisconsin. Air velocities ranged from a minimum of 455 to a maximum of 1120 fpm and averaged 762 fpm over the sample surface.

Weighing Enclosure

Since it was considered highly important to weigh the pans in the atmosphere of the chamber, an enclosure was built inside the chamber to protect the pans from air movement. Fig. 5 shows the enclosure in place with one door open and a pan resting on the support ready to be weighed. A probe covered with sponge rubber, which extended into the enclosure from below, was used to arrest the motion of a pan within the enclosure before weighing. The enclosure was placed directly below an opening in the top of the chamber that permitted a fine wire suspension to be lowered from the arm of a balance on top of the chamber to the pan support in the enclosure.

Balances

Balances for weighing the dry and wet pans were placed on an adjustable platform on top of the chamber (Fig. 6). An analytical balance sensitive to 0.0001 g was used to weigh the dry pans. A triple-beam balance sensitive to 0.1 g was used to weigh the wet pans.

The microphone and amplifier visible in the background of Fig. 6 were part of an intercommunication system assembled for the convenience of the operators, one of whom was inside the chamber to place the pans on the support in the weighing enclosure, while the other manipulated the balance.

Sealers

A mixture of 60 percent microcrystalline and 40 percent refined paraffin wax was used to seal specimens in the dry pans. The sealing medium for the wet pans was a rubber-base liquid adhesive that was used in conjunction with aluminum foil to define the test area and prevent edge leakage. The aluminum foil, which was mounted on wax paper for support, was cut into strips, each 1.5 in. wide and 14 in. long, one of which was used for each side of each pan.

Desiccant and Wet-Pan Filler

The desiccant used in the dry pans was anhydrous calcium chloride.

Wet pans were partially filled with water to provide approximately 100 percent relative humidity, sphagnum moss to provide a large surface for evaporation and to prevent surging of water when handling pans, and a fungicide to prevent mold or fungus growth or chemical action that might evolve a gas and produce a pressure within the pan.

Templates

Templates to define the specimen area, to register this area properly with respect to the pan, and to aid in applying the sealing material are shown in Fig. 4.

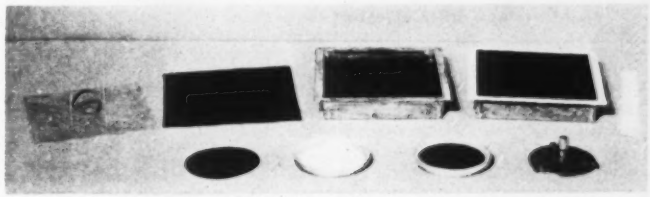

Fig. 4—Components, templates, and completed assemblies of dry and wet pans

(L. to R.) Top row: template, specimen, copper pan containing water and sphagnum moss, completed pan with specimen on top, and aluminum-foil strips. Bottom row: specimen, aluminum pan with calcium chloride, completed pan with specimen on top, template.

Test Procedure

Because the materials to be tested were submitted in various quantities and forms, no standard sampling procedure could be followed. Some material was received in the form of 16- × 16-in. pieces, other material in rolls. The test specimens for any one material were obtained from widely scattered portions of the roll or from different 16- × 16-in. squares. In some cases, however, because of the insufficient amount of material supplied, no choice in the manner of cutting out the test specimens was permitted.

A dry pan was filled with calcium chloride granules to within 0.1 in. of the surface that supported the test specimen. The specimen, cut to the same size as the larger face of the template, was placed in the pan. A thin coating of zinc stearate powder was applied to the sloping edge of the template with a cloth, in order to prevent the wax from sticking to the template. The template was placed on the specimen, and molten wax was poured into the annular space between the pan and the template. When the wax had cooled and solidified, the template was carefully removed and the voids left by the template guide arms were filled with wax. The pan was weighed and placed in the rack in the test chamber. Pans were weighed periodically until a constant rate of change of

Fig. 3—Pan rack with round dry pans in wooden inserts and square wet pans placed directly in rack

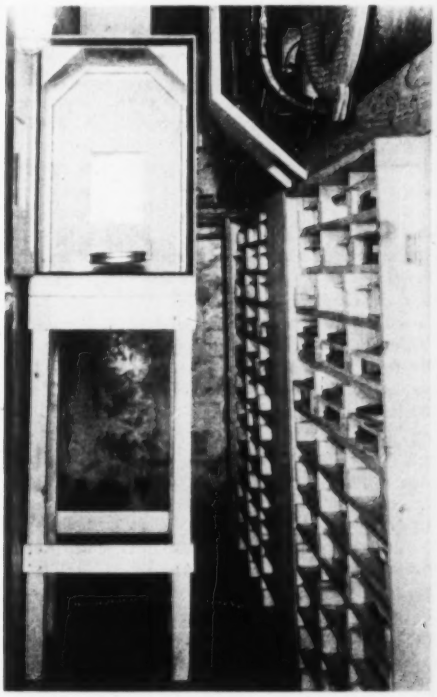

Fig. 5—Interior of vapor-permeability test chamber with weighing enclosure at left and racks at right.

One door of the enclosure is open to show a dry pan on its support, suspended by a fine wire attached to the analytical balance above the roof of the chamber

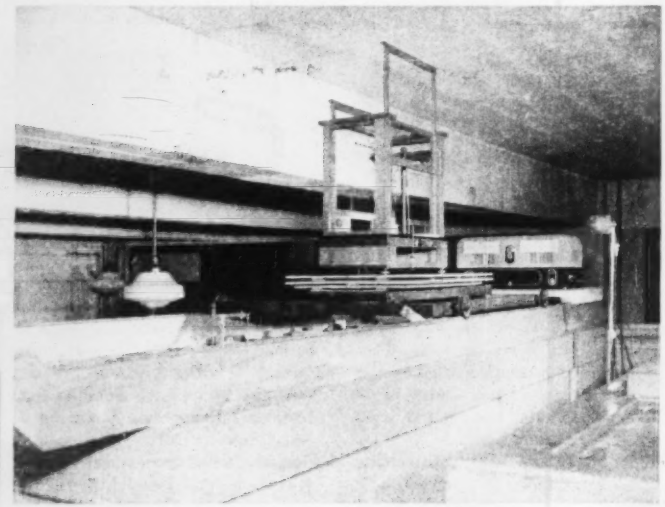

Fig. 6—Analytical balance and communication equipment on top of the chamber

weight was observed. The permeability of the material was calculated from the constant rate of weight change.

A coat of adhesive was brushed onto both sides of the flange of a pan and allowed to dry at least an hour. The pan was filled with distilled water to within 1 in. of the test specimen, and enough sphagnum moss to cover the water surface was placed in the pan. A predetermined quantity of the fungicide solution was added to the water. A specimen was cut to the size of the pan, including the flange. The template was placed in the middle of the specimen, and the adhesive brushed onto the edge of the specimen extending beyond the template and allowed to dry for at least an hour. A second coat of adhesive was applied to both flange and specimen, and the two were pressed firmly together 5 minutes after applying the second coat. The aluminum strips that covered the edges of the specimens were spread with adhesive, dried, respread, and applied with the same timing as was used for the test specimen. The pan was weighed and placed in a test-chamber rack. It was weighed periodically until its rate of change of weight became constant. Permeability was calculated from the constant rate of weight change.

The preparation of the dry pans deviates from *ASTM Tentative Standard Procedure* C214-47T only in the substitution of zinc stearate powder for petrolatum to prevent wax from adhering to the metal template. The zinc stearate has two distinct advantages: (1) it does not unite with any material likely to be tested by the dry method or the wax sealer, and (2) any of it that may remain on the specimen can be removed with a light puff of air or a few strokes of a soft-brush.

The method of preparing a wet pan, according to *ASTM Tentative Standard Procedure* C214-47T, is nearly the same as that for the dry pan. Pans used in the present work had a much larger area (100 sq in.) than the *ASTM* minimum requirement (about 10 sq. in.). The sphagnum moss served to prevent surges of water when the pans were handled and to provide a large surface for evaporation of water and thereby to insure a practically saturated atmosphere at the lower surface of the sample. The fungicide was added to prevent mold or fungus growth. The method of sealing previously described is quite different from the *ASTM* method. It is relatively simple, and tests proved it to be entirely satisfactory.

Results of Tests

All of the materials tested are listed in Table 1 by groups. The table gives a description of each material, the mean vapor-permeability value, and the coefficient of variation for tests performed by both the dry and wet methods. Two values are given for those materials having faces that differ from each other. The face designated as *up* in the table was exposed to the atmosphere of the chamber. Although there is no satisfactory way to indicate the variability of a very small number of values, the coefficient of variation was chosen as the best means of expressing varjations within the individual materials. It is expressed in percentage and determined as follows:

$$(\sigma/\bar{x}) \times 100 = \text{coefficient of variation}$$

$$\sigma = \sqrt{\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1}}$$

where

σ = standard deviation
x = individual value
$\bar{x}$ = mean
n = number of values

Table 2 gives the permeability values arranged in ascending numerical order. Values obtained by the dry method and by the wet method are presented separately.

There is a considerable range in the values of the coefficient of variation; where this value is large it is a good indication of non-uniformity of material. The variability found in the material tested would appear to warrant the use of a large number of samples. A large coefficient of variation would be relatively unimportant for material having a permeability value considerably below a specified maximum, but it would be highly important for a material having a permeability value near a specified maximum. In the latter case, a material would be questionable and perhaps rejected on the basis of its unreliability.

The various materials differed greatly in mean vapor-permeability values (Table 1), ranging from approximately 0 to about 100 grains per (square foot) (hour) (in. Hg). The wet method yielded values nearly always greater than those determined by the dry method; moreover, the ratio of the two values was not constant. The majority of the materials that had low permeability values by the dry method had low permeability values by the wet method. One of the several exceptions to this general trend was sample No. 1001 (single-sheet vapor barrier with fire-resistant coating on both sides), which had a low value, 0.189, by the dry method, and the relatively high value of 29.383 by the wet method.

It is evident that the wet method is a more rigid test than the dry method, because many materials that fell in classes A and B when tested by the dry method failed to meet specifications for these classes when tested by the wet method. All of the materials that fell in classes A and B when tested by the wet method fell in class A when tested by the dry method. Materials that did not fall in classes A, B, or D, were placed in class C, although no specifications were given for this class.

Further investigation is needed to determine the causes of the differences found between the two test methods, and whether materials acceptable by one method of test and not by the other offer adequate protection when used as a vapor barrier. A single standard procedure would be desirable for all sheet material, but it should be correlated with service tests to establish its validity as a permeability test.

Table 2—Water-Vapor Permeability Mean Values in Increasing Numerical Order, Expressed in gr per sq ft per (hr) (in. Hg)

Dry method				Wet method			
Permeability	Sample number	Permeability	Sample number	Permeability	Sample number	Permeability	Sample number
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
0.000	1613 (U)[1]	0.362	1210	0.027	1613 (U)	1.660	605
.001	1705 (D)	.377	1806 (D)	.041	1614	1.660	1107
.002	1613 (D)	.389	1209	.122	1802	1.684	2001 (D)
.002	1705 (U)	.399	1608 (D)	.130	106	1.702	1104
.003	1805 (D)	.443	1617 (U)	.143	104 (U)	1.752	1603
.005	1805 (U)	.447	609	.158	105	1.774	1000 (U)
.012	2000 (D)	.473	1112	.163	1705 (D)	1.801	1617 (U)
.017	1802	.498	103	.176	1705 (U)	1.839	1501
.027	1202	.504	1111	.180	1803	1.864	1604
.027	1208	.504	1709	.228	1613 (D)	1.976	602
.030	106	.524	1708	.239	100	2.014	1600
.030	1200	.526	1619	.248	2000 (D)	2.031	1500
.032	104 (U)	.527	605	.252	1804	2.194	1102
.033	104 (D)	.560	1801	.293	1203	2.335	1105
.035	105	.583	1101	.331	2000 (U)	2.391	1106
.052	100	.583	1617 (D)	.366	1202	2.398	1602
.080	1203	.654	1105	.376	1208	2.423	1210
.081	1803	.657	1104	.422	1706	2.454	1601
.107	2000 (U)	.703	1704	.446	1616 (D)	2.477	1004 (U)
.116	1000 (D)	.711	1603	.451	1103	2.815	1205
.133	1004 (U)	.774	1205	.460	1610	2.835	1004 (D)
.146	1005	.805	602	.566	400	2.917	1215
.156	1804	.840	1106	.581	1200	3.447	1801
.162	1616 (D)	.846	1215	.583	1906 (D)	3.465	103
.189	1001	.850	1113	.589	1616 (U)	3.612	1000 (D)
.205	1620	.884	1110	.623	1301	3.845	610
.226	1301	.935	1214 (D)	.743	1211	3.939	603
.227	1700	.971	102	.768	609	4.234	1806 (U)
.230	1614	1.037	1214 (U)	.806	1617 (D)	4.370	1805 (U)
.232	1616 (U)	1.081	1600	.835	1612	4.873	1605
.237	1004 (D)	1.207	1800	.864	1619	5.564	102
.241	1612	1.241	1107	.876	1700	5.661	1800
.253	1000 (U)	1.560	101	.908	1620	5.741	1214 (D)
.258	1502	1.812	603	.925	1100	6.184	1213
.274	1608 (U)	2.007	1206	.976	1708	6.369	1214 (U)
.279	1611	2.145	610	.984	2001 (U)	6.394	1207
.280	1103	2.469	1707	1.006	1109	7.044	1707
.287	400	3.022	1207	1.024	1611	8.158	1206
.296	1500	3.159	1213	1.046	1005	9.355	101
.296	1115	3.267	1212	1.067	1502	9.429	1701
.300	1116	3.612	1701	1.072	1805 (D)	9.755	607
.304	1503	4.055	1204	1.119	1209	11.916	1703
.305	1102	6.197	607	1.197	1609	12.235	1702
.323	1706	7.447	1703	1.232	1302	16.515	1710
.327	1806 (U)	7.987	1702	1.257	1608 (U)	18.234	1204
.330	1211	11.656	1710	1.349	1709	20.231	1212
.345	1100	30.764	606	1.377	1503	29.383	1001
.346	1501	33.204	1201	1.430	1607	36.323	1201
.349	1302	99.230	1300	1.491	1108	41.926	606
.354	1114	99.223	608	1.547	1101	66.897	1621
		99.345	1621	1.585	1704	67.807	608
				1.612	1606	76.615	1300
(Continued in columns 3 and 4)				(Continued in column 7 and 8)			

[1] U indicates "up" face, D "down" face, of numbered specimens, as described in table 1.

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PRESIDENT'S LETTER

Dear Fellow Members in ASHVE:

Well, we're "back in the saddle again". Since the summer meeting in Muskoka we've left it pretty much to the committees to carry on ASHVE work. Chapters do not hold regular meetings and golf, vacations and gardens take the front interest. The Korean War is vitally close or remote depending on your exposure.

Executive Committee met in Cleveland in August. I had the pleasure of visiting with the members of the Guide Committee, Research Executive Committee and the entire Research Committee on their visits to Cleveland this summer and fall.

The accessibility of our Laboratory was proved again when the Council gathered in Cleveland for meeting on Sunday, October 22nd. This was the first Council meeting since February 1948 that we have had 100% Council attendance. Isn't that wonderful? From all corners of the country they came; Hamlet from Montreal, V. P. Szekely from Milwaukee, Haines from Minneapolis, Kroeker from Portland, Oregon (summer meeting 1951), Spurlock from Denver (new Council nominee), Gardner from Dallas (winter meeting 1950), Treas. Taylor from Houston (V.P. Nominee), Allen from Kansas City, Evans (Chapt. Conference) from St. Louis (winter meeting 1952), Sproull, Cincinnati (Treas. nominee), Boyd from Atlanta, Leopold from Philadelphia, Mackey from Cornell and Queer from Penn State, V. P. Seeley from Durham and that completes the ring centered around Cleveland. Inside the ring we had P. P. Stacey from Syracuse, James from Chicago, Supple from Indianapolis, Cross (Research Committee) from Chicago.

Director Tasker acted as host at the Laboratory serving an excellent box lunch and his staff took the Council members through the Lab after lunch where we saw the new Psychrometric Rooms for making panel heating and cooling, and physiological reaction studies and the new Human Calorimeter. Both projects are scheduled for completion this winter. Officers from the Northern Ohio Chapter joined us for lunch and Ralph Sherman (past Council member) dropped in on us at dinner at the Statler Sunday night. Oh yes, we snapped the black whip — worked from 9:30 a.m. to 6:00 p.m. at the Lab, recessed for dinner and finished off the job at 10:30 p.m. — a long day.

Again I say we owe much to these able men who take time from a busy life full of their own problems to work on Society affairs, not only at these meetings but between meetings, each on his own committee activity. This year the 3-year term of Council members Hamlet, Sproull, Leopold, and Allen end. They have worked hard and with imagination and it has been a great pleasure to work with them. Howard Sproull goes on in office as nominee for Treasurer. I hope we can find new duties for the others as they are the kind of men you can depend on. Thanks to them for their help and enthusiastic cooperation.

Past President Stacey completes his term on Council and we shall greatly miss him.

It is appropriate here to mark the passing this year of three of your Society past Presidents: E. Vernon Hill, William H. Driscoll and Willis H. Carrier, all of whom gave greatly of their time and treasure to make this Society what it is today. Those of us now in office pledge ourselves to follow the paths they laid out. We, in our way and our time, will try to make ASHVE more vital, significant and of greater service.

But what did we do at Council of interest to you? It seems there were several significant actions worthy of note.

It was decided to place Research Fund Raising in charge of the Finance Committee by forming a sub-committee called the Ways & Means Committee. For the balance of this year Ernest Szekely as Chairman of the Finance Committee will act as Chairman and Vice President Seeley, Research Chairman Robert Cross; Chapter Relations Chairman, John Haines; and Public Relations Chairman, Charles Price will constitute the balance of the committee. They will implement the fund raising program.

You will note that we now place the financial responsibility for the research funds in the same place as other funds so that Research Committee, TA Committees and the Director and his staff can plan and execute their programs without spending time on fund raising. We want the help of all these people but the responsibility for funds is placed directly in the lap of the Ways & Means Committee under the Finance Committee. We *hope* this plan *will work*.

There was considerable discussion of the Charter and By Laws Committee's comments on the Chapters Plan Committee report referred to it in June.

It was decided to make the Public Relations Committee a continuing activity so the By-Laws will be amended to permit the inclusion of this committee in the General Committtee group.

We were given another lesson in By-Laws and Rules by our legal counsel, Mr. Eisner and as a result, propose to have each committee formulate an "Operational Guide". This is *not* a legal or binding instrument but will serve as the outline of what the committee is supposed to do and how, which should help new members. It should be emphasized in this connection that the pattern for "Rules" — "Rules of Procedure", "Regulations" and "Operational Guide"—is yet to be spelled out in words that "an ordinary eighth grader" can understand. Howard Sproull is undertaking to do this with his Charter & By-Laws Committee and when they have the formula worked out the Engineers will be given the go ahead to complete the reaction. This is a new kind of fusion — I hope not more confusion.

Your Society is in good financial health. Bills are paid promptly and money is in the banks. 8341 members as of October 1, 1950, 44 Chapters and 11 Student Branches. Don't worry about it, with the present men on Council and committees and the known character of the men coming in, your Society is in safe hands. We are trying to plan to serve you better. If you have any suggestions, they will be welcome and given proper consideration.

Monday night, October 23rd, we had the pleasure of presenting the Charter to the Miami Valley Chapter — Dayton, Ohio. They start out with over 40 members and a potentiality and enthusiasm that will soon take it to the hundred mark. Ned Stacey presented the Charter and Howard Sproull gave them the record books. Over 25 members came from Cincinnati — real cooperation. Congratulations and best wishes to the 44th Chapter at Dayton.

Philadelphia meeting in January promises to be the largest in our history. The 10th International Heating & Ventilating Exposition is completely sold out, the greatest ever. Portland, Oregon for the Summer meeting of 1951, St. Louis (without Exposition) for January 1952, that's the plan, subject, of course, to change due to defense conditions.

We recognize the individual responsibility of each member to play his part in this national emergency. We are waiving dues for men in active service. We are cooperating with government agencies and stand ready to do more when called on. By our joint efforts, individually as working members of industry or profession, by our research work and cooperative effort in ASHVE we are striving in our own way to keep freedom of thought, action and opportunity safe against the attacks of communism.

This Society — THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS is unique among Societies in this country, is not paralleled by any similar society abroad and simply could not exist under the totalitarian state. Let us not lose our privilege by complacency or neglect. It is truly a democratic institution commanding the voluntary interest of the top men in the profession. Let us keep it that way.

Sincerely

Lester T. Avery, President

Losses from a Floor-Type Panel Heating System

By F. W. Hutchinson*, Berkeley, Calif., D. L. Mills** and L. J. La Tart†, Rome, N. Y.

SUMMARY—This paper presents the results of an investigation on heat losses from two floor-type panel heating systems during the 1948-49 and 1949-50 heating seasons. Edge and rear losses were of the order of 30 percent of the total energy supplied so it may be concluded that insulation is necessary with floor-type systems if economical operation is desired. In addition to the loss data, experimental results are also presented giving the actual rating of a unit area of floor panel and the combined film coefficient of heat transfer for such a panel as evaluated from tests on the actual system; the latter results are of particular interest in that they permit conclusive decision as to the applicability of the laboratory tests of other investigators to actual field installations.

TEN YEARS ago a research program was initiated at the University of California to investigate analytically and experimentally the effectiveness and operating characteristics of various types of panel heating and cooling systems. The part of this program which dealt with fundamentals of design was carried on cooperatively under the sponsorship of THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS; subsequent projects have been undertaken with respect to the rating and thermal characteristics of various types of panel construction.

As the program developed it became evident that wide discrepancy existed between the results obtained in laboratory tests and the results which were said to occur in actual installations. Direct comparison was difficult, however, because precise experimental methods can only be used on a field installation when adequate and costly instrumentation is provided. Three years ago an exceptional opportunity developed for carrying out an extensive experimental check on an actual installation, but with instrumentation sufficient to permit achieving laboratory accuracy. At that time a new building 25 ft by 60 ft (with an 11 ft 6 in. ceiling) was made available. Although this structure was intended for regular occupancy it was nonetheless equipped at the time of erection with some hundreds of embedded thermocouples and with all other instruments and controls needed for accurate testing of the heating system. Detailed descriptions of the building[1] and of its heating system[2,3] and instrumentation[4] are available in the literature. Various technical articles from this *field laboratory* have presented results of studies on panel rating[5] and on the influence of embeddment depth[6] on uniformity of surface temperature.

As tests of the actual system proceeded it became evident that losses of heat either through the floor slab or around the periphery were very much greater than indicated by common belief. During the first heating season that the system was in operation losses were estimated at from 25 to 35 percent, but data from these early tests were not considered sufficiently conclusive to justify publication. During the 1948-1949 and the 1949-1950 heating seasons, the subject of losses was selected for comprehensive investigation. This paper presents the results of the study. In addition to the loss data, experimental results are also presented giving the actual rating of unit area of floor panel and the combined film coefficient of heat transfer for such a panel as evaluated from tests on the actual system; the latter results are of particular interest in that they permit conclusive decision as to the applicability of the laboratory tests of other investigators to actual field installations.

System Thermal Characteristics

The heating system on which a majority of the tests were run consisted of a sinuous coil floor panel occupying 118 sq ft of surface in a room having 220 sq ft of floor area. The coil was fabricated of 3/4 in. copper tube (7/8 in. O.D.) on 9 in. centers. Embeddment was in a 4 in. concrete slab poured on top of a 6 in. fill of gravel; the coil was leveled so that the distance from the top of the tube to the panel surface was 1/2 in. As an overall check on the results of tests from this one system a few additional tests were made on a different panel of equal area and the same construction, but with an embeddment depth of 1 in. rather than 1/2 in.

Data from the two systems were recorded throughout the two heating seasons, but for the purposes of loss determination only a very few periods were suitable for complete tests. In order for data on losses to have general significance it is essential that conditions closely approaching equilibrium exist at the time of the test. With a heated floor slab, however, equilibrium is rarely realized as each change in weather necessitates altering the energy input to the slab and each change in slab temperature leads to readjustment of

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[1]Exponent numerals refer to Bibliography.
For presentation at the 57th Annual Meeting of THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Philadelphia, Pa., January 1951.

temperature gradients throughout a huge mass of earth extending some feet below the gravel fill on which the slab rests. The earth has a relatively low thermal conductivity and a relatively high thermal capacity (product of specific heat and of density) so long time lags intervene between a thermal change and re-establishment of thermal equilibrium. Even when weather changes are of a minor degree there may be a significant adjustment of gradients immediately below the slab with consequent departure of instantaneous loss rates from the more significant average values.

During periods in which the heating load is increasing, losses will occur at rates higher than those corresponding to equilibrium, whereas during intervals of decreasing load the rate of losses will be much less than equilibrium values. Considered for the heating season as a whole these transient losses seem to average at a value not greatly different from the integrated seasonal value based on assumed maintenance of steady state, but use of the instantaneous transient rates would lead to serious error. As an example of the importance of this circumstance consider a floor slab which is operating at steady load with a surface temperature of 80 F: The earth immediately below the slab will be at some equilibrium temperature (the value depending on type and thickness of slab as well as on the type of fill and the type of soil) usually somewhat higher than the panel surface temperature. If, now, the load on the system drops sharply, the heat supply to the panel would be cut off and as equilibrium tended to be restored the rate of instantaneous loss to the earth would decrease and in some cases, would reverse.

During test runs on the actual system under conditions of decreasing load, negative loss rates were repeatedly observed, thus showing that for such transient periods heat was flowing from storage in the earth back up through the slab. In such cases the energy which at some earlier period was *lost* from the slab is now regained and effectively utilized in meeting part of the heating load. Unfortunately the reverse-flow usually occurs at a time when the actual heating load is very small; in such cases the returned *losses* may enter the heated space at a rate exceeding the heating requirements and thereby lead either to overheating or to further losses due to the need of excess ventilation for maintaining a comfortably low room temperature.

For the above reasons, acceptable periods for testing slab losses are very few and much time and care must be devoted to selection of test periods during which the system is assuredly in a state reasonably close to that of equilibrium. Each of the tests reported in this paper was made near the end of a period of stable weather and at a time when thermal conditions within the room and within the slab were known (from periodic readings) to be practically constant.

Table 1—Experimental Data from All Tests

Test Number		System No. 1			System No. 2
		No. 1	No. 2	No. 3	No. 1
Room air temperature at 48 in. level, t_a	F	67.0	68.5	70.0	74.0
Water temperature, entering coil, t_e	F	99.5	99.0	105.0	105.0
Water temperature, leaving coil, t_l	F	92.0	92.0	95.0	96.5
Panel surface temperature, t_{s1}	F	81.0	80.5	85.0	87.0
Panel surface temperature, t_{s2}	F	81.0	80.0	77.0	85.5
Panel surface temperature, t_{s3}	F	85.0	77.0	80.5	86.5
Panel surface temperature, t_{s4}	F	76.5	84.0	88.0	86.5
Panel surface temperature, t_{s5}	F	80.0	84.0	84.0	85.0
Panel surface temperature, t_{s6}	F	...	...	...	87.5
Flow rate to coil,	gpm	1.16	1.16	1.16	1.20
Heat meter reading, Q_m	Btu/sq ft/hr	26.9	25.1	29.4	25.4
Room floor area, A_f	sq ft	220	220	220	144
Unobstructed panel area, A_u	sq ft	110	110	110	106
Partially obstructed panel area, A_o	sq ft	0	0	0	5
Completely obstructed panel area, A_c	sq ft	8	8	8	7
Total panel area ($A_u + A_o + A_c$), A_p	sq ft	118	118	118	118

Procedure

Since the rooms under test were regularly occupied during the hours of the workday, the air temperature maintained was not established by the test group, but left under control of the occupants. As previously stated, tests were only made following periods of stable temperature, but over the two heating seasons the occupants did make many adjustments in room air temperature. Hence, the air temperatures shown for the various tests are not the same.

Table 1 presents a summary of all test data relevant to the present report. Three tests are reported for one heating system and a single check test for a second heating system. In all cases air and surface temperatures were obtained from calibrated thermocouples whereas temperatures of the water entering and leaving the heating coil were obtained from calibrated thermometers (accurate to 0.1 F) and checked with thermocouple readings; both thermometers and thermocouples were installed in thermometer wells in the mains immediately ahead of and immediately following the heating coil. Flow was determined from readings of a calibrated meter located near the entrance to the coil. A standard surface-type heat meter, also calibrated, was used to obtain the total rate of heat loss (radiation plus convection) from unit area of the heated floor surface to the room. For the first system panel surface temperatures were recorded at five points (shown as t_{s1}, t_{s2}, t_{s3}, t_{s4}, and t_{s5} in Table 1); for the second system six such temperatures were recorded.

Analysis of Test Data

For purposes of the present report the word *loss* is used to designate the difference between the quantity of energy supplied to the heating panel and the quantity of energy transferred from the upper surface of the panel to the occupied space. (Refer to the section on *Discussion* for an explanation of the conditions for which this term may be a misnomer). The total energy input to the panel is given by,

$$Q_i = (8.345)\ (60)\ (\text{gpm})\ (t_e - t_l) \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where,

Q_i = total heat input to the heating panel expressed in Btu per (square foot) (hour),

gpm = experimentally determined flow rate through the sinuous coil,

t_e = temperature of the water at entrance to the coil.

Table 2—Summary of Results

Test Number	System No. 1				System No. 2	
	No. 1	No. 2	No. 3	No. 4	No. 1	No. 2
% Loss (Based on uncorrected panel area)	27.0	27.4	25.4		29.4	
% Loss (Based on corrected panel area)	30.1	30.2	28.6		55.5	
Film coefficient (Btu/hr/sq ft/F deg)	2.02	2.09	2.28	2.28	2.25	2.20

t_i = temperature of the water at exit from the coil.

The total heat transferred from the panel surface to the room in Btu per hour is given by the expression

$$Q_m A_p \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where,

Q_m = experimentally determined heat meter reading.

A_p = area of the panel.

Now let Z equal the percentage of total energy input which is lost from the edges and from the rear of the panel and note that 100 — Z is then equal to the percentage of input which is transferred from panel surface to the room; then

$$Q_m A_p / Q_t = (100 - Z)/100 \ldots (3)$$

where,

Z = the only unknown and hence can be solved for.

One difficulty exists, however, in the accurate evaluation of panel area. In the room tested, as would be true in most actual floor-panel heated rooms, some obstruction of panel surface existed. Of a total heated area of 118 sq ft, 8 sq ft (6.8 percent) was covered by a worktable with cabinets under it that extended to the floor. The heating effect realized from this completely obstructed area would obviously be something less than from other parts of the panel hence, if this reduction were not taken into account, the value $Q_m A_p$ would be unduly small and the resultant calculated value of the losses, Z, would be less than the true value. One method of correction would be to assume that the upward heat flow from the obstructed panel surface is some fraction of the upward flow from equal area of unobstructed surface. Considerable difficulty exists in determining a numerical value for this fraction, but if it is assumed to be conservatively small the resultant value of Z would be greater than the true value and one could then deduce that the true value of Z is necessarily between the values obtained with uncorrected panel area and with corrected panel area. This procedure will be demonstrated with sample calculations for test No. 1 with the first heating system (data read from Table 1):

Substituting test data into Equation 1,

$$Q_t = (8.345)\ (60)\ (1.16)\ (99.5 - 92)$$
$$= 4350$$

Substituting into Equation 3,

$$(26.9)\ (118)/(4350) = (100 - Z)/100$$

giving,

Z = 27 percent for *uncorrected* panel area

To determine an expression for use with the corrected panel area, let X equal the fraction of edge and rear losses from unobstructed heating surface to upward transfer from unobstructed surface. Then the total energy input to unit area of unobstructed panel would be,

$$Q_u(1 + X) \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Now assume that losses from obstructed surface are the same as losses from unobstructed surface, but that upward transfer from such surface is only 10 percent of that from unobstructed surface; the total energy input to unit area of obstructed surface would then be,

$$Q_u(0.1 + X) \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

and the total energy input to the entire heating panel would be,

$$Q_t = Q_m A_u (1 + X) + Q_m A_o (0.1 + X) \ldots\ldots (6)$$

where,

A_u = area of unobstructed heating panel.

A_o = area of completely obstructed heating panel.

The only unknown in Equation 6 is X, hence, this term can be solved for and the losses, Z, subsequently calculated from the relationship,

$$Z = (100)\ (X)/(1 + X) \ldots\ldots (7)$$

Now substituting the test data for test No. 1 into Equation 6,

$$4350 = (26.9)\ (110)\ (1 + X) + (26.9)\ (8)\ (0.1 + X)$$

giving,

$$X = 0.434$$

and then from Equation 7,

$$Z = (100)\ (0.434)/(1 + 0.434)$$
$$= 30.1 \text{ percent losses for corrected panel area.}$$

The true losses from the panel are therefore between 27 percent and 30 percent with the higher figure probably being closer to the true value.

The above sample calculations are representative of those for the first three tests which are reported (Table 1) for the first system. For the second system the method of calculation for uncorrected panel area is no different from the method for the first system, but for the corrected area an additional term appears in Equation 6 to take account of partial obstruction over a 5 sq ft area of panel due to cabinets that come within 2 in. of the floor. Here, again, an assumption is necessary as to the influence of the partial obstruction; upward transfer of heat from this section has been taken as 20 percent of that from unobstructed panel; the revised form of Equation 6 is then,

$$Q_t = Q_m A_u (1 + X) + Q_m A_o (0.1 + X) + Q_m A_o (0.2 + X) \ldots\ldots (8)$$

where,

A_o = partially obstructed panel area.

An additional calculation permits evaluation of the combined film coefficient for radiant and convective transfer from the panel surface to the room. If the experimentally determined panel surface temperatures given in Table 1 are averaged and if the average is identified as t_s, the film coefficient h will then be obtained from the equation

$$Q_m = h(t_s - t_r)$$

or

$$h = Q_m/(t_s - t_r) \text{ Btu per (hr) (sq ft) (F deg)} \ldots\ldots (9)$$

Discussion of Results

Table 2 summarizes the results obtained from the data of Table 1 by the methods described in the preceding section. Losses based on uncorrected panel area are seen to range from 25.4 percent to 27.4

percent for the first system whereas the corresponding losses based on corrected area range from 28.6 percent to 30.2 percent. Differences of this order of magnitude are of no practical significance and, considering the difficulty of achieving steady state in a system of this type, the extent of the agreement of test results seems almost fortuitously good.

For the second system the losses are indicated as being slightly greater than for the first, but since only one test is reported this difference cannot be interpreted with any degree of assurance. The main purpose of the single run on the second system was to provide an overall check on the results from the first system and the authors suggest that the extent of agreement between results from the two systems is surprisingly close. From theory one would expect a slight increase in losses from the second system since the depth of tube embeddment is 1 in. as compared with ½ in. bury for the first system; this difference in systems may explain the indicated difference in results, but such an explanation cannot be considered conclusive on the basis of a single test.

Interpretation of the term *loss* requires recognition of the three ways in which energy leaves the sides and the rear of a heating panel. For the two systems on which tests were conducted the heating panel did not occupy the full floor area of the room, hence part of the energy which was *lost* from the heating panel undoubtedly served to warm adjacent unheated floor area and thereby contributed to the ultimate heating of the room. In terms of system effectiveness this fraction obviously is not a true loss. The remaining energy which escapes from sides and rear of the heating panel is either lost to the earth directly below the unit or is lost peripherally to the surrounding earth. In seeking means of increasing the thermal effectiveness of a floor panel, a first step would be to separate the peripheral and vertical losses and thereby determine the extent to which use of peripheral insulation would reduce the total losses of the system; it is hoped that data related to such a separation can be obtained during the 1950-1951 heating season and presented in a subsequent paper.

The film coefficients resulting from these tests (see Table 2) are of particular interest in that they provide direct substantiation, from an actual field installation, of the results obtained in the laboratory by Wilkes and Peterson[7]. Much disagreement has existed as to the rating of floor-type heating panels, but the present results seem to indicate that ratings of actual panels do not appreciably differ from ratings obtained in the laboratory under controlled conditions. For a panel designed to operate at surface temperature of 85 F in a room with air temperature of 70 F, both laboratory and field tests now show that the total upward heat transfer (the panel rating) will be from 30 to 35 Btu per (hr) (sq ft). There have been many expressions of opinion to the effect that ratings much higher than this occur, but so far as the authors have been able to determine there has never been any published data, obtained under precise test conditions, to substantiate belief in a rating higher than 35 Btu per (hr) (sq ft) for an 85 F floor panel in a 70 F room.

During the heating season preceding the one in which the heat loss studies were started, data were obtained from the same two systems and used in calculations[5] of film coefficients based on *assumed* losses of 10 percent. In Table 2 test No. 4 on the first system and test No. 2 on the second system present recalculated values of the film coefficients based on revised losses equal to the values obtained from the other tests; it will be noted that on this basis the earlier tests give film coefficients almost identical with those obtained from the series of tests reported in this paper.

Conclusions

Over a two year period tests were conducted on two floor-type panel heating systems installed in regularly occupied rooms of an industrial building. Both systems used ¾ in. sinuous coil copper tube on 9 in. centers and in each case the coil was embedded in a 4 in. concrete slab poured over a 6 in. gravel fill. No insulation was provided either under or at the sides of the slab, or of the structure, and in each case the heated section of floor was less than total floor area. Cellular insulation, ¾ in., separated heated from unheated floor sections.

Edge and rear losses (which could not, in these tests, be separated) were found to agree very closely on all tests and to be of the order of 30 percent of total energy supplied to the heating system. Based on these results it is evident that some type of insulation is required with floor-type panel heating if the operating cost is to be kept at a reasonably low value.

The film coefficients of heat transfer calculated from test data agreed very closely with the values obtained by other investigators and suggest that an acceptable design value of combined (radiation and convection) film coefficient for floor heating panels is 2.1 Btu per (hr) (sq ft) (F deg temperature difference from panel surface to air).

Acknowledgment

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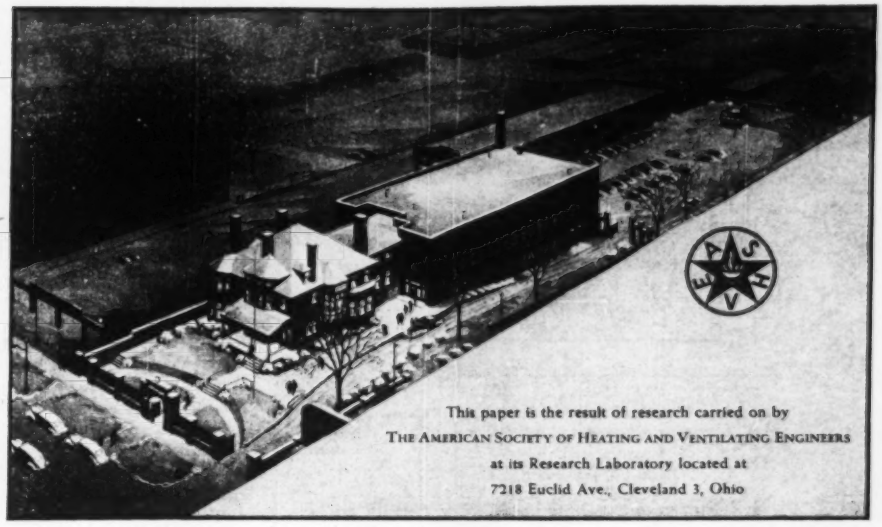
This paper is the result of research carried on by
THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS
at its Research Laboratory located at
7218 Euclid Ave., Cleveland 3, Ohio

Rating of Fuel Oils By a Test Unit

By David W. Locklin* and George V. Parmelee**
Cleveland, Ohio

This paper is the result of research carried on by THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, in cooperation with the *Oil-Heat Institute of America, Inc.*, at the ASHVE Research Laboratory, located at 7218 Euclid Avenue, Cleveland 3, Ohio.

SUMMARY—This investigation was made to determine the extent to which a fuel oil combustion test unit, designed by the *Oil-Heat Institute of America, Inc.*, could be used to distinguish between and reproduce the burning qualities of different fuel oils as indicated by smoke density and flame length at a given percent CO_2. Five of six oils tested gave satisfactorily reproducible results. Factors which affect reproducibility and smoke density are discussed briefly. The data showed good correlation with common indices of combustion.

A PROPOSED method of measuring the burning characteristics of fuel oils is to study their combustion in a test unit which closely simulates typical field conditions and to compare oils on the basis of their observed burning performance. A test unit designed and constructed for this purpose by the *Oil-Heat Institute of America, Inc.*, was studied by the ASHVE Research Laboratory and is the subject of this paper. A previous paper[1] described the methods used in determining smoke density of the combustion products. This paper describes briefly the unit, the standardized test procedure used, and the results of tests on six different oils. The oils are rated on the basis of their smoking tendencies at given rates of air supply. The ability to obtain reproducible results by means of the test unit was determined and the influence of certain operating conditions on the burning qualities of a given fuel was investigated. A long range view of the uses of this unit includes the establishing of a simple test or index which can be used in the field to determine the burning quality of fuel oils.

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[1]Exponent numerals refer to References.
For presentation at the 57th Annual Meeting of THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Philadelphia, Pa., January 1951.

Description of Test Unit

Fig. 1 shows a schematic diagram of the unit and a portion of its instrumentation. The ASHVE Research Laboratory engineering staff made certain changes during the course of this study and completed most of the instrumentation. Fig. 2

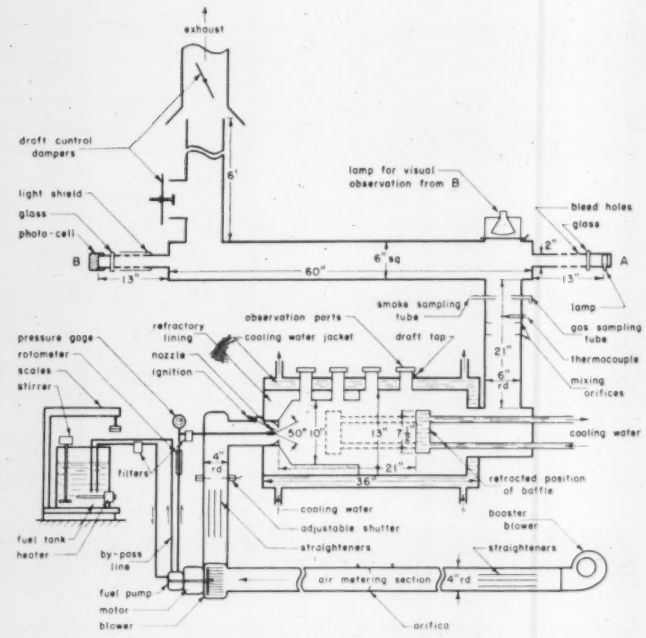

Fig. 1—Schematic elevation of test unit

shows a view of the unit and test equipment.

Basically, the unit consists of a pressure atomizing type burner firing axially into a cylindrical water jacketed combustion chamber, a portion of which is lined with refractory material as shown. The nozzle has a nominal capacity of 1 gph and produces a hollow-cone spray. Flame length was determined by adjusting the movable water-cooled baffle and noting the position at which the flame tips just reached the baffle surface. Air supply and combustion chamber draft were controlled by adjusting (1) the cold air inlet damper located in the stack, (2) the butterfly damper in the stack, and (3) the iris type air supply shutter.

Test Procedure

Oils Tested

To study the performance of the unit tests were made on six different fuel oils which, from field experience, were known to have different burning characteristics. The properties of these oils, designated alphabetically, are shown in Table 1; the latest *Commercial Standard* specifications[2] are also given for comparison.

Standard Test Conditions

Since the purpose of the test unit was to rate oils with regard to their burning characteristics, it was necessary that all oils be tested under identical conditions. It was found impossible, however, to meet this requirement with respect to constant weight rate of oil flow through the nozzle without changing the oil line pressure. An effort to compensate for differences due to density and viscosity by supplying the oil at different temperatures was unsuccessful. Hence the following test conditions, hereafter referred to as *standard conditions*, should not be regarded as indicating identical combustion conditions:

Oil delivery pressure:
100 psig ± 1 psig

Oil supply tank temperature:
110 F ± 2 deg

Cooling water discharge temperature:
145 F ± 5 deg

Combustion chamber draft:
0.020 in. water ± 0.002 in.

Air metering orifice:
2 in. diameter

Baffle position: Fully retracted, except when measuring flame length

Ignition: On

The indicated temperatures were chosen primarily because good control was obtainable at these levels. A warm-up time of approximately one hour was allowed before data were taken, since preliminary investigation showed that this time was required to reach equilibrium.

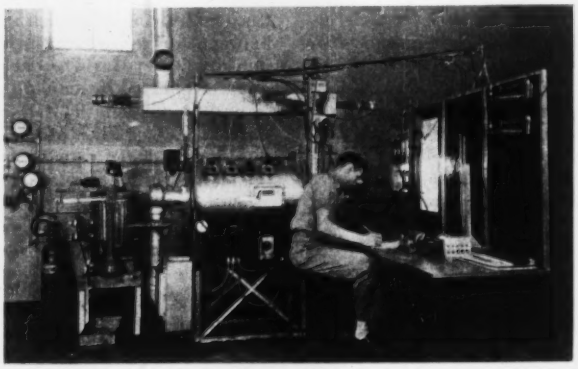

Fig. 2—The *test unit* during tests

The performance of each of the six oils was first investigated under standard conditions of operation by at least a dozen tests in which the air supply was varied in steps over the range of about 8 to 15 percent CO_2. These tests are designated as original tests. Check tests over the same range were later made to investigate reproducibility. Tests were then made to determine the effect on fuel rating of different conditions of ignition, turbulence, and oil supply pressure.

Table 1—Properties of the Fuel Oils Investigated

Fuel Oil	A	B	C	D	E	F	Commercial Standards[a] No. 1 Max.	No. 1 Min.	No. 2 Max.	No. 2 Min.
API Gravity	39.4	27.5	22.6	45.4	34.0	25.9	—	35	—	26
Flash Point, deg F	146	200	174	134	176	176	—	100	—	100
Viscosity at 100 F										
S.U. sec.	33.0	34.1	35.1[b]	36.5	35.0	35.0	35.5[b]	—	40	—
Centistokes	—	—	2.15	—	—	—	2.2	1.4	4.3[b]	—
Distillation, deg F										
I.B.P.	340	474	378	350	368	418	—	—	—	—
10%	395	511	416	374	455	454	420	—	440	—
50%	446	548	480	425[b]	500[b]	500	—	—	—	—
90%	500	609	548	474	582	567	—	—	675	—
E.P.	616	652	610	518	650	640	625	—	—	—
Pour Point, deg F	−20	—	−45	0	−5	−20	0	—	20	—
Sulfur, %	0.588	0.88	0.275	0.11[a]	0.25	0.56	0.5	—	1.0	—
Water and Sediment, %	Nil	0.1	Trace	Nil	Trace	—	Trace	—	0.1	—
Carbon Residue, % at 10% Bottoms	0.036	0.16	0.44	0.207	0.092	0.004	0.15	—	0.35	—
Refining Process	Straight Run	Cat. Cracked	Therm. Cracked	Unknown Blends			Not Specified			

[a]Estimated Values
[b]Specifications from *Commercial Standard* CS 12-48. Ref. 2.

Test Results

In the absence of any primary standard of combustion, the value of the test unit must be judged by its ability to give reproducible results in the measurement of the combustion characteristics of fuel oils, the performance of which is already known in a qualitative way. Measured combustion characteristics are discussed first. In this regard it should be noted that, except for starting and shutdown tests, each value of smoke spot reflectance plotted in this paper is an average of reflectance measurements of four separate filter smoke spots. Each corresponds to a CO_2 determination by an Orsat made on two successive gas samples. If the CO_2 determinations failed to check, the test was repeated.

Smoke data are plotted against CO_2 for oils A and B in Figs. 3 and 4, respectively; the solid curves are representative of data obtained under the standard conditions of operation. The ordinate scales in these and subsequent figures have been plotted to indicate increasing smoke in a vertical direction. Each of the other oils yielded similar curves. Except for oils B and E there was no marked accumulation of soot in the combustion chamber. In the case of these two oils, a heavy deposit of feathery soot on the refractory occurred above approximately 12.5 percent CO_2 for oil B and about 13.5 percent CO_2 for oil E. An increase in smoke was exhibited by oil B at the higher air supply rates as illustrated in Fig. 4 by the probable trend of the curve for standard conditions.

The results shown by the solid line curves of Figs. 3 and 4 have been replotted in Fig. 5 to summarize the relative smoking tendencies of the six oils tested. All curves except 1 and 2 are for the standard conditions.

CO_2 in Percent of Ultimate CO_2

Fig. 5 differs from Figs. 3 and 4 in that the abscissa is CO_2 expressed as a percentage of the ultimate CO_2. The ultimate CO_2 for each oil was derived from gas analyses by plotting values of percent O_2 *vs* CO_2 and extrapolating this straight line to zero O_2. Hydrogen-carbon ratios

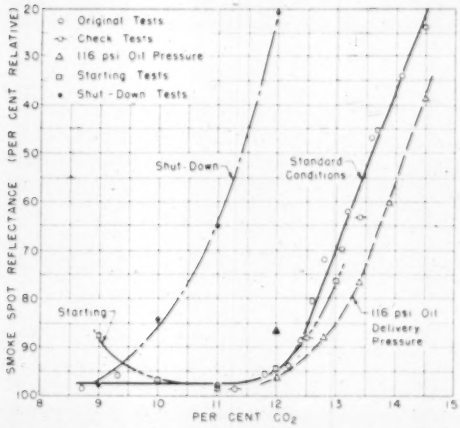

Fig. 3—Smoking characteristics of oil A (15.50 percent ultimate CO_2)

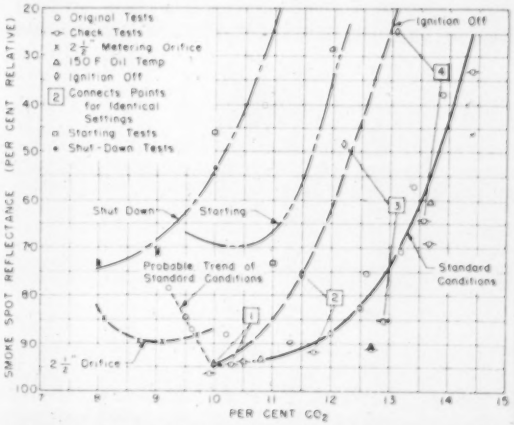

Fig. 4—Smoking characteristics of oil B (16.05 percent ultimate CO_2)

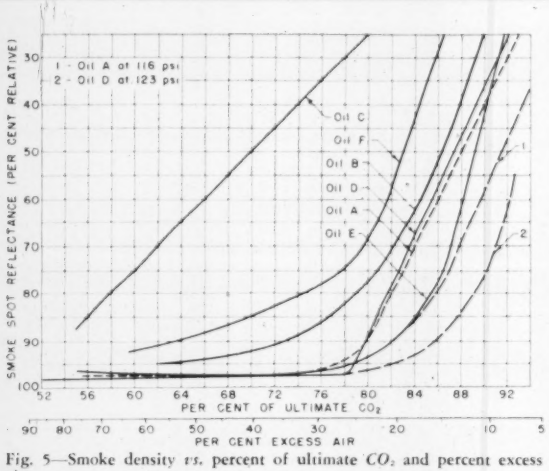

Fig. 5—Smoke density *vs.* percent of ultimate CO_2 and percent excess air

were determined by their relation to the ultimate CO_2.

By considering smoke density with respect to CO_2 expressed as percent of ultimate CO_2, oils having different hydrogen-carbon ratios can be compared in relation to their actual air requirements. The relation of this concept to the familiar scale of percent excess air also is shown in Fig. 5 for convenience in comparison. Although this relationship theoretically depends to a small extent upon the hydrogen-carbon ratio, the range of this ratio for the oils investigated has negligible effect. Use of the concept of CO_2 in percent of ultimate CO_2 has the advantages of spreading the scale in the lower range of excess air, resulting in clearer presentation, and of comparing oils relative to their performance with perfect combustion.

Increased Delivery Pressure

Delivery rates of oils B, C, E, and F when fired at the standard conditions of operation varied less than 5 percent on a weight basis, although slight variations were observed with respect to time and air supply rate. The respective delivery rates for oils A and D at standard conditions were about 6 and 10 percent below the average for the other oils. In order to investigate the relative performance of all oils at similar firing rates, some tests were made with oils A and D fired at higher delivery pressures.

It was possible to increase the firing rates of oils A and D to the level of the other oils by increasing the pressure from 100 to 116 and 123 psig, respectively. Data obtained with these delivery pressures, other conditions remaining standard, are plotted in Fig. 3 for oil A and are shown as dashed curves in Fig. 5 for both oils A and D; it may be seen that a material decrease in smoke production accompanied the increase in delivery pressure. Stack temperatures were increased about 40 F by the higher delivery pressures. (Indicated stack temperatures for tests at standard conditions varied from 850 to 950 F, depending upon the excess air supplied.)

For the different oils investigated it was found that the effects of delivery temperatures and pressure on nozzle delivery rate could be approximated by considering the weight rate of oil flow to be proportional to the square root of the product of density and delivery pressure.

Flame Length

The flame lengths for the various oils were closely related to their smoking tendencies. Fig. 6 shows summary curves of flame length *vs.* percent excess air for the standard conditions of operation. The flame length at constant values of excess air and the smoke corresponding to a constant flame length are shown in Table 2, tabulated in order of decreasing *API*† gravity for the six oils.

When oil D was fired at 123 psig the relationship of flame length and excess air became practically identical to that of oil E fired at 100 psig; no appreciable change in flame length characteristic was obtained when the firing pressure of oil A was increased from 100 to 116 psig. The flame length data of the various oils should not be considered as wholly indicative of their relative burning qualities since variable characteristics of ignition, atomization, and mixing may affect the flame length of one oil more than another.

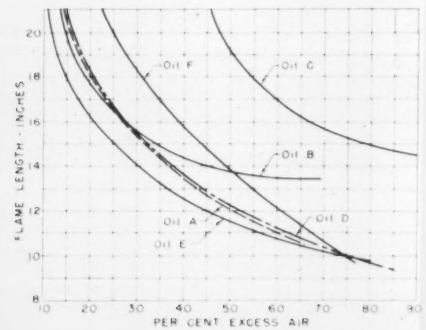

Fig. 6—Flame length summary (Standard conditions)

†American Petroleum Institute.

Table 2—Flame Length of Various Fuel Oils

Oil Designation	D	A	E	B	F	C
API Gravity—deg	43.4	39.4	34.0	27.5	25.9	22.6
Flame Length (inches)						
For 25% Excess Air	16.6	16.6	15.0	16.5	20.0	>21.0
	15.0[a]	16.0[a]				
For 50% Excess Air	12.2	12.0	11.5	13.8	13.8	19.2
	11.5[a]	12.0[a]				
Smoke Spot Relative Reflectance At 16-Inch Flame Length	98	95	91	83	84	79
	100[a]	96[a]				

[a]Higher than standard delivery pressures.

Effect of Air Shutter Opening

For metering the higher rates of air supply a 2½ in. diameter orifice was used, making it necessary to set the air control shutter at a smaller opening in order to keep the air supply system resistance the same. It became evident that the relationship between smoke spot reflectance and percent CO_2 was altered when a larger metering orifice was used; this is illustrated in Fig. 4.

The effect of air shutter opening seemed so significant in the operation of the unit that it was investigated further by several tests using oil B at a constant air-fuel weight ratio of 20.9 and a draft of 0.10 in. water. By dampering the inlet to the booster blower the shutter could be set at different positions without changing the air flow rate or combustion chamber draft. Results of these tests, plotted in Fig. 7, indicate that there was a marked effect of shutter opening upon combustion.

It was believed that the air turbulence set up by different shutter openings persisted into the combustion chamber and was responsible for changing combustion by altering the characteristics of air-fuel mixing.

Ignition off

Due to occasional fouling of the ignition electrode tips, arcing took place across the electrodes away from the tips and in certain cases arcing ceased completely. In an attempt to determine the maximum effect of this faulty ignition several tests were made with oil B, first with the ignition on and then with the ignition off. These data are plotted in Fig. 4; the numbered lines connect data obtained with ignition on and with ignition off at a given setting of controls. It was noted that there was a marked increase in air supply rate when the ignition was turned off, and this resulted in a decreased CO_2, although smoke density was considerably greater.

Therefore it appeared that the method of maintaining ignition, whether by electric arc combined with radiation and flame propagation or merely sustained by radiation and flame propagation, has a definite bearing upon air flow to the combustion chamber and upon smoke production.

Starting and Shutdown

During the investigation, smoke densities occurring at starting and shutdown were measured in order to indicate the relative smoking tendencies of the various oils at these times. The capacity of the fuel line, increased by instrumentation and filters, may have contributed to sluggish starting and oil cut-off to such an extent that smoking was greater at these times than normally exists in practice.

When starting the unit from cold, the smoke sampling unit was started simultaneously with the pump and fan motor; a second sample was then

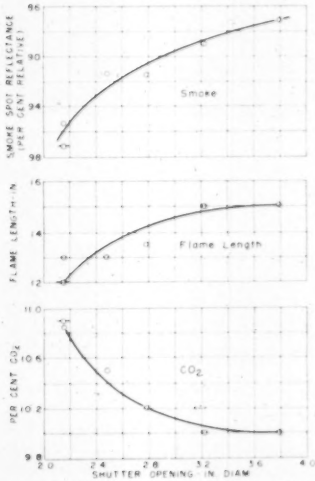

Fig. 7—Effect of shutter opening at constant air-fuel ratio

Table 3—Combustion Indices and Test Results

Oil Designation	Note	D	A	E	B	F	C
Combustion Indices							
API Gravity, deg	a	43.4	39.4	34.0	27.5	25.9	22.6
Aniline Point, deg F	a	147	143	137	121	89	55
Diesel Index	b	63.8	56.5	46.6	33.3	23.0	12.4
I.P. Smoke Point	a	22	21	11	8	6	8
Burning Index	c	93	80	71	49	36	25
Cetane Number	d	45	50	51	49	29	19
U.O.P. Charact. Factor	e	11.83	11.58	11.56	11.37	10.99	10.66
Test Results							
Ultimate % CO_2, U	f	15.35	15.50	15.60	16.05	16.15	16.40
Hydrogen-carbon Ratio	g	0.1525	0.1474	0.1433	0.1275	0.1244	0.1161
Percent of Ult. CO_2							
For 80% smoke spot refl.							
At standard conditions	h	81.5	82.0	85.5	79.0	74.5	58.0
At similar firing rates	i	80.0	86.0	85.5	79.0	74.5	58.0
For 50% smoke spot refl.							
At standard conditions	h	87.5	88.0	89.0	86.1	83.0	70.0
At similar firing rates	i	93.0	93.5	89.0	86.1	85.0	70.0
Smoke Spot Rel. Reflect.							
For 80% of Ult. CO_2							
At standard conditions	h	88.0	89.5	93.0	77.5	68.5	25.0
At similar firing rates	i	96.5	93.5	93.0	77.5	68.5	25.0
For 87% of Ult. CO_2							
At standard conditions	h	52.0	55.0	72.0	46.0	21.0	6.0
At similar firing rates	i	87.5	75.0	72.0	46.0	21.0	6.0

Notes:
(a) Values taken from oil analysis submitted by refiners
(b) Diesel Index = (*API* gravity x aniline point) /100
(c) Obtained from chart (Fig. 4 of Ref. 5)
(d) Obtained from graphical solution chart (Ref. 6) based on Institute of Petroleum formula: cetane number = 175.4 log (mid pt.) + 1.98 *API* deg — 406
(e) U.O.P. Characterization Factor = (Cubic Av. Boiling Pt., Deg F. + 460)$^{1/3}$/Specific Gravity at 60 F (Refs. 7 and 8)
(f) Determined from gas analyses
(g) Calculated from relation: H/C = (20.9/U)—110.421
(h) Data obtained when all oils were fired at 100 psig pressure and 110 F (Fig. 5)
(i) Data obtained when all oils were fired at essentially the same weight rate (Oils A and D fired at pressures greater than 100 psig) (Fig. 5)

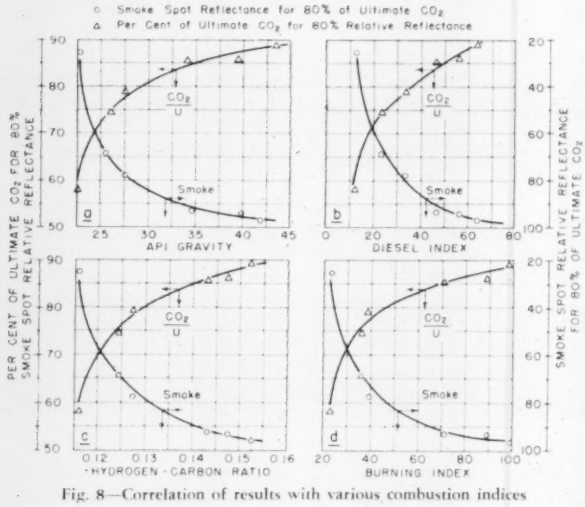

Fig. 8—Correlation of results with various combustion indices

taken immediately after the first as a comparison of starting to steady operation after starting. Similarly, prior to shutdown a smoke spot was taken and then the sampler was started as the unit's motor was switched off. Smoke spot reflectance data for two oils at starting and shutdown are plotted against the steady operating values of CO_2 in Figs. 3 and 4. (A few points which aided in establishing the curves fell beyond the range shown.) Smoke density during the starting period was greater than during steady operation, with the exception of oils A and C, but was less than during shutdown. Other data show similar results for conventional burners.[3, 4] Impingement or dribble of the oil upon the refractory surfaces occasionally was observed at shutdown.

Reproducibility of Results

Satisfactory reproducibility was obtained for all of the oils except oil C, for which the scatter of smoke data for both original and check tests was as much as 30 percent relative reflectance. Oils C and D burned with greater instability than the other oils, in that detonation and pulsation were much more prevalent. When firing oil D at 123 psig pressure this unsteady combustion sometimes became quite severe.

One factor contributing to the lack of reproducibility for some tests is believed to be the variation of ignition characteristics. Spark position could not be observed while the unit was in operation so the actual condition of ignition during tests was unknown. Gumming of the electrodes could be observed only after shutdown. It is conceivable that variations in spark position could cause deviations in smoke density approaching the ignition-off values (previously illustrated in tests of fuel B) as a limiting condition; this might account for some of the dispersion of test points.

Correlation of Test Results with Combustion Indices

The results obtained were compared with certain of the indices which are generally considered to be indicative of the burning qualities of fuel oils. The comparison is shown in Table 3 where the six oils are arranged in order of decreasing *API* gravity; values of the indices were obtained as indicated in the notes. The test results given in the tabulation were taken from Fig. 5. For purposes of this comparison the smoking tendency of each oil is based on CO_2 in percent of ultimate CO_2 corresponding to smoke spot relative reflectances of 80 and 50 percent. Also shown is the smoke spot reflectance for CO_2 values of 80 and 87 percent of ultimate CO_2; these values correspond respectively to excess air quantities of 23.5 and 14.0 percent. Results are compared both on the basis of the standard conditions of operation and on the basis of similar firing rates obtained when the oils A and D were fired at pressures greater than 100 psig.

The curves of Fig. 8 were prepared to permit greater ease in visualizing the correlation of the test results with the various combustion indices. Results for similar firing rates are plotted in Fig. 8 against the following indices:

a. *API* Gravity
b. Diesel Index
c. Hydrogen-Carbon Ratio, *H/C*
d. Burning Index

Values of CO_2/U (where U = ultimate CO_2) plotted in Fig. 8 are the maximum values of percent of ultimate CO_2 which may be attained without exceeding smoke densities of 80 percent relative reflectance. (This corresponds to smoke number 3 on the Bacharach-Shell scale[3].) Also shown are smoke densities obtained at CO_2 = 80 percent of ultimate CO_2.

API gravity, hydrogen-carbon ratio, diesel index, and burning index seem to be the most indicative of the burning qualities of the oils tested, while U.O.P.* characterization factor and cetane number show a weaker correlation. It may be observed from Table 3 that very poor correlation was obtained with the I.P.† Smoke Point. The aniline point became more indicative of the burning quality when combined with the *API* gravity in the form of the diesel index. Although technique and conditions of operation in the preliminary investigations differed somewhat from those described here, the results with those oils followed the correlations of Fig. 8 quite closely.

Several points of caution should be emphasized in making generaliza-

*Universal Oil Products Co.
†International Petroleum Technologists

tions from these results and correlations. Variables which affect combustion are so inter-related that it is impossible to control each independently. For example, the comparison of data on the basis of similar firing rates has the disadvantage of including effects of unequal delivery pressures on atomization and mixing. When the oils are considered on the basis of the standard conditions of operation (constant delivery pressure) the relative smoking tendencies are seen to be different from those at similar firing rates and thus correlate differently with the burning indices shown. The air shutter position required for a given percent of excess air varied somewhat with different oils, tending to change the relative air-fuel mixing characteristics (Fig. 7). Due to differences in oil spray characteristics, the optimum requirements of ignition position could possibly vary for the different oils. These factors tend to indicate that the data presented should not be considered to be comparable in the strictest sense.

The data presented are the results obtained for the *oils used in this investigation* and do not necessarily indicate the relative intrinsic burning qualities of these fuels, nor does the correlation with the combustion indices indicate that such a correlation could be applied for all types of oils. It should be pointed out that relatively few oils have been investigated and that the burning qualities of a number of widely different oils of the same type, such as catalytically-cracked oils, might not follow the correlations presented. These correlations are encouraging however, and it is possible that they could be firmly established by tests with a greater number of oils; thus a simple determination such as *API* gravity might be found to be indicative of the burning qualities as evaluated by the test unit.

Conclusions

1. Satisfactory reproducibility of results was obtained with all oils except oil C, for which combustion was quite unstable.

2. In addition to increasing the firing rate, the effect of increasing the delivery pressure of the oil was to produce cleaner combustion and a slightly shorter flame.

3. At constant air-fuel ratio the effect of decreasing the air shutter opening was to reduce smoke density and flame length, while increasing percent CO_2.

4. The effect of switching the ignition off during steady operation was to increase the air supply rate and to increase smoke production.

5. Smoke densities during shutdown were greater than during starting; and smoke densities during starting were generally higher than during steady operation.

6. A good degree of correlation was obtained between test results at similar firing rates and the following combustion indices: *API* gravity, hydrogen-carbon ratio, diesel index and burning index. A greater number of oils must be investigated if these correlations are to be so established that a simply obtained index can be used to rate the burning qualities of fuel oils. Investigation should be made to determine whether these correlations may be extended to other types of burners and to field installations.

7. In order to determine the significance of the results obtained with the test unit, it would be desirable to investigate fundamental principles of fuel atomization, ignition, air-fuel mixing, and smoke measurement.

Acknowledgment

The authors acknowledge with thanks the cooperation and suggestions received from their colleagues of the ASHVE Research Laboratory staff and members of the Engineering Committee of the *Oil-Heat Institute of America, Inc.*

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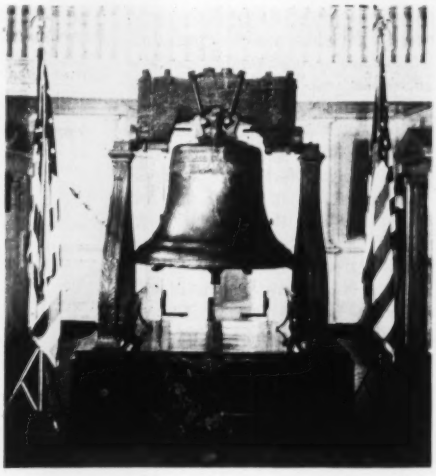
NEW PUBLICATION BY BUREAU OF STANDARDS

A summary of scientific investigations carried on at the National Bureau of Standards during the fiscal year 1949 is contained in a 101-page illustrated booklet just published by the National Bureau of Standards. These investigations were conducted by divisions concerned with electronics, applied mathematics, atomic and radiation physics, radio propagation, electricity and optics, metrology, heat and power, chemistry, mechanics, organic and fibrous materials, metallurgy, mineral products, and building technology. Of the numerous and varied projects carried on, those of greatest general interest and widest application included: development of an atomic clock controlled by the constant frequency of vibration of the atoms in the ammonia molecule; production of a synthetic mica having essentially the same valuable properties as the corresponding natural mica; development of a practical method of preparing extremely thin sections of organic materials for study with the electron microscope; perfection of a process for increasing the wear of sole leather by impregnating it with rubber; and the determination of the magnetic moment of the proton. Space is given to extensive programs in such fields as electronic computers, radio propagation, building technology, corrosion, low-temperature physics, high polymers, and aeronautical research. (NBS Miscellaneous Publication 198, *Annual Report of the National Bureau of Standards* for 1949, is available from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C. at 75 cents a copy.)

57th ANNUAL MEETING IN PHILADELPHIA

January 22-25, 1951



The Liberty Bell

AT ITS November 9 meeting, the Committee on Arrangements of the Philadelphia Chapter completed final plans for the 57th Annual Meeting, January 22-25, 1951. Chairman A. J. Nesbitt announced a detailed program of events for the Meeting which was developed by the Committee on Arrangements, and the program for the technical sessions was released by Chairman John James of the Society's Program and Papers Committee.

The registration of visiting members and guests will start on Sunday, January 21, at the Bellevue-Stratford Hotel, and the Council and Committee on Research, and a number of other committees have scheduled meetings during the day.

At 4:00 p.m. on Sunday there will be a Welcome Tea for the visiting members and ladies. Registration of members and guests will commence at 10:30 a.m. on Sunday in the Oak Room of the Bellevue-Stratford. The Reception Committee, of which J. Owen Kirkbride is chairman, will also maintain information booths at the Benjamin Franklin, the Warwick and at ASHVE Booth 88. Registration will be continued from Sunday through Thursday, and members will be supplied with badges, programs and other desired information.

An advance copy of the Program and a cordial invitation from the Chapter to come to Philadelphia has been mailed to members, together with a reservation form for the social events. The Committee on Arrangements is hopeful that prompt reservations will be made.

An elaborate technical program has been planned by the Program and Papers Committee and six sessions will be held. Morning sessions are scheduled at the Bellevue-Stratford Hotel and afternoon sessions on Tuesday and Wednesday will be held at Convention Hall, adjacent to the Exposition. In this way it is hoped that many members who are engaged in activities of the Exposition will have an opportunity to attend some of the technical sessions.

It will be noted that the first session will open on Monday morning with Pres. Lester T. Avery presiding. Reports of officers will be read, and the technical papers will cover panel heating and cooling studies.

On Tuesday morning the opening report will be from the Tellers of Election and the technical papers to be presented are devoted to combustion studies on bituminous coal, fuel oil and smoke measurement. Tuesday afternoon will provide reports on electrostatic precipitation and heat pump performance. A Symposium on "Man and His Relationship to Air" will be held Wednesday morning with Prof. Nathaniel Glickman as moderator and the speakers will be Dr. Eugene F. DuBois, Dr. Robert W. Keeton and Charles S. Leopold.

At the fifth session on Wednesday afternoon the subjects to be discussed are snow melting, effective heat for steam heated structures and transportation heating and controls. The final session on Thursday morning will have papers on solar radiation and axial flow fans as the main topics. The newly elected officers will be installed at this session and adjournment is scheduled for noon.

Exposition

The 10th International Heating and Ventilating Exposition will open in the Commercial Museum at 2:00 p.m., January 22. Every space has been taken to show a wide variety of new products and this will be the largest display of heating, ventilating and air conditioning equipment ever held. There will be many "firsts" among the exhibits. A number of the exhibits will be devoted to fuel utilization and conservation. Air conditioning for winter and summer service will be extensively displayed and air purification and treatment will be an important phase among the exhibits. Admission will be by special tickets available from exhibitors or the show management. The Exposition is under the direction of Charles F. Roth and E. K. Stevens is the associate manager.

Entertainment

Members and ladies are invited to attend a get-together luncheon scheduled for 12:15 p.m. on Monday in the ballroom of the Bellevue-Strat-

ford Hotel. The speaker will be announced.

At 3:00 p.m. the ladies will be entertained in the Greek Room of John Wanamaker's, following which tea will be served.

For the Monday evening entertainment a novel party is planned at the Hotel Benjamin Franklin. The theme for the evening's entertainment will be "A Night with the Pennsylvania Dutch". From 7:00 p.m. to 12:00 p.m. there will be a buffet style hot supper served in the Betsy Ross and Franklin Rooms featuring Pennsylvania Dutch dishes.

In the ballroom at 8:30 p.m. a Pennsylvania Dutch play will be presented — "Papa Is All". At 10:00 p.m. square dancing will start with an old time Dutch caller. At 12:00 p.m. a special entertainment will be presented and some interesting surprise numbers are scheduled for the entertainment of members and ladies.

On Tuesday morning the ladies will assemble for "brunch" at the Warwick Hotel at 10:30 a.m., followed by a bus tour to historic places in Old Philadelphia with stops at Independence Hall and Betsy Ross House, then to Valley Forge, which is about 15 miles outside of Philadelphia. It was here that Washington encamped during the winter of 1777-78 with his Continental troops. Washington's headquarters are preserved and a stop will be made here and also at the Chapel.

Commercial Museum

The Past Presidents of the Society will have their annual dinner at 6:30 on Tuesday evening.

On Wednesday at noon the ladies will enjoy a luncheon and fashion show at the Warwick Hotel, and at 7:00 p.m. the ballroom of the Bellevue-Stratford will be the scene of the Annual Banquet. The toastmaster will be Merrill F. Blankin, past president and honorary chairman of the Committee on Arrangements. The past president's emblem will be presented to Lester T. Avery.

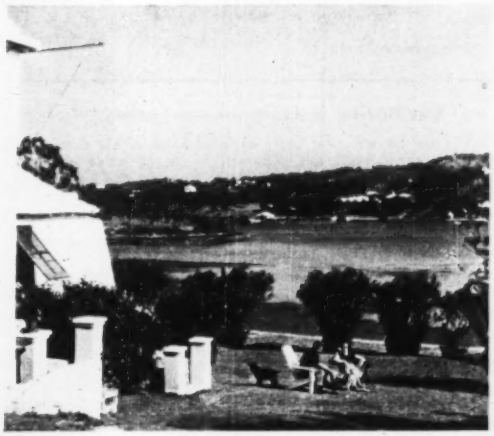
On Thursday morning a bus trip to Atlantic City is planned for the ladies, with luncheon at Captain Starns and the return to Philadelphia will be about 6:00 p.m.

On Friday the 10th International Heating and Ventilating Exposition will be open from 12 o'clock noon until 6:00 p.m.

On Saturday those who plan a post meeting trip will sail from New York at 3:00 p.m. on the *Queen of Bermuda* for a cruise to Bermuda and Nassau.

Seven days of pleasure where you can lead the *Life of Riley* and do just as you please. On arrival at Hamilton, Bermuda, there will be time to take the finest sightseeing trips on the island, including the South Shore Drive, with its numerous estates, Harrington Sound and a visit to quaint old St. George. Stops can be made at Devil's Hole, Crystal Cave, and the Aquarium. There will also be time for shopping in the famous shops in Hamilton. In Nassau there will be an afternoon and evening for sightseeing, swimming, and other amusement. There will be a profusion of flowers everywhere and amateur photographers are advised to record their trips in colors, in either still or movies.

Arrangements for the trip should be made with Leon V. Arnold, 36 Washington Square W., New York 11, N.Y., and inquiries regarding rates, plan of ship, etc., should be sent directly to him by air mail or wire.



Entering Hamilton Harbor in Bermuda

PROGRAM 57TH ANNUAL MEETING

THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Bellevue-Stratford Hotel—Hotel Benjamin Franklin—Warwick Hotel

January 22-25, 1951

Saturday—January 20

10:00 a.m. Committee on Research
1:30 p.m. Executive Committee of Council

Sunday—January 21

10:00 a.m. REGISTRATION (Bellevue-Stratford—*Oak Room*)
Council Meeting
4:00 p.m. Committee on Research
4:00 p.m. Welcome Tea (Bellevue-Stratford—*Clover and Red Rooms*)
Hostesses: Mmes. A. J. Nesbitt, F. H. Buzzard, E. H. Dafter, M. G. Kershaw, J. W. McElgin, E. K. Wagner

Monday—January 22

9:00 a.m. REGISTRATION (Bellevue-Stratford—*Oak Room*)
9:30 a.m. FIRST SESSION (Bellevue-Stratford—*Rose Garden*)
Pres. Lester T. Avery presiding
Welcome to Philadelphia
Response by President Avery
Reports of Officers and Council
Losses from a Floor-Type Panel Heating System, by F. W. Hutchinson, D. L. Mills and L. J. La Tart
Field Studies of Heat Losses from Concrete Floor Panels, by C. M. Humphreys, C. V. Franks and L. F. Schutrum
Design Factors in Panel and Air Cooling Systems, by Charles S. Leopold
12:15 p.m. GET-TOGETHER LUNCHEON (Bellevue-Stratford—*Ballroom*)
2:00 p.m. EXPOSITION—Opening of 10th International Heating and Ventilating Exposition (Commercial Museum)
Exhibit will open daily from 12 noon to 10:00 p.m., Tuesday to Thursday, and will close at 6:00 p.m. on Friday
ASHVE Booth No. 88
2:00 p.m. Chapters' Conference Committee
3:00 p.m. Ladies Tea with Entertainment
John Wanamaker's (*Greek Room*)
Hostesses: Mmes. A. J. Nesbitt, F. H. Buzzard, E. H. Dafter, M. G. Kershaw, J. W. McElgin, E. K. Wagner
7:00 p.m. to "A Night with the Pennsylvania Dutch" (Hotel Benjamin Franklin—*Ballroom*)
12:00 p.m.
Hot supper, buffet style, Pennsylvania Dutch dishes served from 7:00 p.m. to 12:00 p.m. in adjoining *Betsy Ross* and *Franklin Rooms*
8:30 p.m. "Papa Is All" (Pennsylvania Dutch Play)
10:00 p.m. Dancing (including square dancing with up-state Dutch old time caller
12:00 p.m. Special entertainment
DON'T MISS THE SWAP SHOP: Bring a gimmick to swap for ????? We Dutch are sharp traders

Tuesday—January 23

9:00 a.m. REGISTRATION (Bellevue-Stratford—*Oak Room*)
9:30 a.m. TECHNICAL SESSION (Bellevue-Stratford—*Rose Garden*) First Vice Pres. Lauren E. Seeley presiding
Report of Tellers of Election
The Efficiency of Bituminous Coal-Burning Space Heaters by J. W. Tieman and F. L. Bagby
The Measurement of Smoke, by K. O. Beatty, Jr. and James E. Deas, Jr.
Report of Committee on Research—R. C. Cross, *Chairman*
Rating of Fuel Oils by a Test Unit, by D. W. Locklin and G. V. Parmelee
*Smoke Measurement in a Fuel Oil Test Unit, by D. W. Locklin and G. V. Parmelee
10:30 a.m. Ladies "Brunch" (Warwick Hotel)
Hostesses: Mmes. M. F. Blankin, W. P. Culbert, H. B. Hedges, C. F. Dietz, J. H. Hucker, R. F. Hunger, J. O. Kirkbride, H. H. Mather, R. D. Touton
11:30 a.m. Bus Tour of Historic "Old and New Philadelphia and Valley Forge"
Lv. from Warwick Hotel—Stops at Independence Hall, Betsy Ross House, The Chapel at Valley Forge, and Washington's Headquarters. Bus returns at 4:30 p.m.

*To be presented by title.

Method of Choosing Location of, Financing and Conducting Meetings of the Society

Resolved: That inasmuch as the Annual and Semi-Annual Meetings of the Society come under the jurisdiction of the Council, the following rules governing the handling of such meetings be adopted by the Council and published in the JOURNAL of the Society at least twice during every year, preferably just prior to each meeting.

1—The Council will select the city in which the Annual or Semi-Annual Meeting is to be held, giving due consideration to the invitations received from Chapters or members as well as to the advisability of so distributing those meetings as to make them of the greatest advantage to the general membership, and to reduce as far as possible the expense of members attending.
2—That an appropriation be made to cover the entertainment or local expenses, incurred in connection with the meeting, and the regular meeting expense to be taken care of by the General Fund of the Society in the regular way.
3—That no registration fee or compulsory obligations of any nature be imposed on members or guests.
4—That the purchase of tickets for banquets or for any other form of entertainment that may be provided be entirely voluntary.
5—That the grouping of features and the sale of tickets for group features be discouraged.
6—That the raising of funds from manufacturers of heating appratatus be discouraged.
7—That the display of samples, or of literature, advertising the product of any manufacturer in any way, shape or form, be not permitted at the booths, registration desk, or in or about the meetings.
8—That the distribution of trade papers be entirely at the discretion of the committee in charge.
9—That the local Chapter or local members be empowered to form a General Committee with such sub-committees as may be required to handle the details of transportation, hotel accommodations, entertainment, finance, etc., and that this General Committee be requested to confer frequently with the Council, through the Secretary of the Society, and to make frequent reports on progress in connection with the various matters being handled by them.
10—That the arrangements of elaborate and costly entertainment features be discouraged.

Adopted at Council Meeting, January 29, 1936

Washington's Headquarters at Valley Forge

12:15 p.m. Guide Committee Luncheon (Bellevue-Stratford)

2:30 p.m. TECHNICAL SESSION (Convention Hall) Second Vice Pres. Ernest Szekely presiding

A Survey of Electrostatic Precipitation by E. A. Walker and J. E. Coolidge

Theory of Earth Heat Exchangers for the Heat Pump, by L. R. Ingersoll, F. T. Adler, H. J. Plass, and A. C. Ingersoll

Factors Useful in Ground Grid Design for Heat Pumps, by George S. Smith

4:30 p.m. Committee on Research (Convention Hall)

6:30 p.m. Past Presidents' Dinner

Wednesday—January 24

9:00 a.m. REGISTRATION (Bellevue-Stratford—*Oak Room*)

9:30 a.m. TECHNICAL SESSION (Bellevue-Stratford—*Rose Garden*) Pres. Lester T. Avery presiding

Symposium—Nathaniel Glickman, Moderator
Subject: "Man and His Relationship to Air"
Speakers: Dr. Eugene F. DuBois, Dr. Robert W. Keeton, and Charles S. Leopold

12:30 p.m. Luncheon and Fashion Show (Warwick Hotel)
Hostesses: Mmes. C. S. Leopold, M. E. Barnard, L. M. Church, John Everetts, Jr., J. H. Hucker, L. E. Moody, Ludwig Mack, W. S. Scott

12:30 p.m. Nominating Committee Meeting

2:00 p.m. TECHNICAL SESSION (Convention Hall) First Vice Pres. Lauren E. Seeley presiding

Operating Experience and Data from Sidewalk Snow-Melting System, by L. A. Stevens and G. D. Winans

Principles of Effective Heat for Steam Heated Structures, by C. O. Mackey, N. R. Gay, R. D. Tutt, E. G. Powell and E. L. Broderick

Heating and Thermostatic Controls in the Transportation Industry, by N. O. Kirkby

*Water-Vapor Permeability of Building Papers and Other Sheet Materials, by E. R. Bell, M. G. Seidl and N. T. Krueger

7:00 p.m. ANNUAL BANQUET (Bellevue-Stratford—*Ballroom*)
Toastmaster: Merrill F. Blankin, past president of ASHVE
Presentation of Past President's Emblem to Lester T. Avery

*To be presented by title.

Thursday—January 25

9:00 a.m. REGISTRATION (Bellevue-Stratford—*Oak Room*)

9:30 a.m. TECHNICAL SESSION (Bellevue-Stratford) Pres. Lester T. Avery presiding

Use of Aircraft Propellers for Axial Flow Fans, by E. C. Lundquist and M. J. Hamilton

Roof Spray for Reduction in Transmitted Solar Radiation, by G. E. Sutton

Solar Energy Transmittance of Figured Rolled Glass, by G. V. Parmelee and W. W. Aubele

Installation of Officers
Unfinished Business
New Business
Resolutions
Adjournment

10:30 a.m. Ladies Bus Trip to Atlantic City
Lv. Hotels at 10:30 a.m. Luncheon at Captain Starns
Lv. Atlantic City at 4:00 p.m. Ar. Philadelphia 6:00 p.m.

12:00 p.m. Committee on Research Luncheon

12:30 p.m. Council Luncheon Meeting

Friday—January 26

12:00 p.m. EXPOSITION—10th International Heating and Ventilating Exposition (Commercial Museum—Closes at 6:00 p.m.)

Saturday—January 27

3:00 p.m. Post Meeting Cruise (Bermuda and Nassau)
Sail from New York on "Queen of Bermuda" (Ar. back in New York on February 5 at 9:00 a.m.)

Philadelphia Chapter

Committee on Arrangements

A. J. Nesbitt, *General Chairman*

M. F. Blankin, *Honorary Chairman*

F. H. Buzzard, *Vice Chairman*

Banquet—M. E. Barnard, Chairman; H. R. James, F. C. Lambert, C. J. Lubking, W. W. Malloy, H. H. Mather, G. W. Powell, Jr., G. E. Tuckerman, F. B. Wilder.

Entertainment—E. K. Wagner, Chairman; R. H. Ackermann, R. J. Augusterfer, H. H. Erickson, H. J. Faltenbacher, H. W. Goldner, J. H. Hucker, R. F. Hunger, L. P. Hynes, M. G. Keyshaw, R. S. Mizener, S. R. Nusbaum, F. F. Pfeiffer, A. M. Robertson, Karl Rugart, Edward Semel, R. J. Siegel, J. K. Walters.

Exposition—C. F. Dietz, Chairman; C. G. Binder, H. W. Doerrfuss, C. J. Forve, Nicola Ginzburg, A. A. Granke, H. E. Grossman, J. E. Heim, J. J. Hucker, Jr., H. K. King, A. E. Kriebel, H. H. Mohrfeld, A. G. Mummer, H. M. Parent, R. M. Sharp, G. F. Smith, W. D. Strause, H. N. Teuber.

Finance—A. C. Caldwell, Chairman; C. B. Eastman, Edwin Elliot, R. J. Lee, L. E. Moody.

Ladies—E. H. Datter, Chairman; G. F. Bertrand, R. H. Smiles. Assisted by—Mmes. R. S. L. Arnold, M. E. Barnard, G. F. Bertrand, M. F. Blankin, F. H. Buzzard, L. M. Church, W. P. Culbert, E. H. Datter, C. F. Dietz, John Everetts, Jr., H. B. Hedges, J. H. Hucker, R. F. Hunger, M. G. Keyshaw, J. O. Kirkbride, C. S. Leopold, Ludwig Mack, H. H. Mather, J. W. McElgin, L. E. Moody, A. J. Nesbitt, E. K. Wagner.

Publicity—W. P. Culbert, Chairman; G. P. Alexander, A. E. D'Ambly, S. E. Plewes, R. D. Touton.

Reception—J. O. Kirkbride, Chairman; L. M. Church, Co-Chairman; R. S. L. Arnold, T. J. Atkins, Lucien Buck, P. A. Cavanagh, S. E. Farrington, H. E. Gross, H. B. Hedges, A. H. Koch, James Marshall, H. G. McCullough, F. B. Millham, H. B. Prewitt, J. T. Quinn, P. S. Schoenjahn, W. S. Scott, C. D. Shields, Pierce Timmis, L. A. Tucker.

Sessions—John Everetts, Jr., Chairman; Alan Dombroff, R. E. Sexton, M. A. Sheffler.

Transportation—Isadore Director, Chairman; E. I. Curley, F. N. Darby, L. C. Davidson, J. E. Hutchison, Ludwig Mack, P. H. Yeomans.

JOURNAL SECTION

Lester T. Avery
Cleveland, Ohio

PRESIDENT AVERY ADDRESSES LOCAL CHAPTERS

Pres. Lester T. Avery spent a busy three weeks in November when his itinerary took him through the South and Southwest where he addressed seven local chapter meetings on the subject, *Dynamic* Air Conditioning, held informal meetings with chapter officers in Dallas, St. Louis and Indianapolis, and discussed the possibility of forming new chapters in Louisville and Wichita, Kans.

President Avery's first stop was in Louisville on November 9, when he met with Society members interested in forming a new chapter. From there he went to Memphis where he addressed the Memphis Chapter meeting on November 10. On November 14, in New Orleans, he was the guest of honor at the Delta Chapter meeting, and on the 15th he arrived at Shreveport, La., in time to speak at a dinner meeting of the Shreveport Chapter.

The South Texas Chapter at Houston and the Southwest Texas Chapter at San Antonio were honored by President Avery's visits to their respective chapter meetings on November 17 and 20. En route to Oklahoma City President Avery stopped off to meet with the North Texas Chapter officers in Dallas at a meeting which was arranged by C. Rollins Gardner, a member of Council.

Oklahoma City was President Avery's next stop, when he spoke before the Oklahoma Chapter meeting on November 22, which was a special meeting arranged to fit in with President Avery's itinerary. In Wichita, Kans., D. M. Allen, member of Council, had arranged for a meeting with Society members on November 24, to discuss the possibilities of forming a chapter.

On the final lap of his November trip, President Avery stopped at Tulsa, Okla., where he addressed the Northeastern Oklahoma Chapter meeting on November 27. J. S. Rosebrough, president of the St. Louis Chapter, arranged for a dinner meeting of the Chapter's officers with President Avery on November 28, during his brief stop. Then on November 29, he met with the Indiana Chapter officers in Indianapolis, a dinner meeting arranged for by Graeme B. Supple, member of the Society's Council.

Mrs. Avery accompanied President Avery on this trip, which was made by car and proved to be most enjoyable.

A. C. BUENSOD ANNOUNCES APPOINTMENT

A. C. Buensod, president of Buensod-Stacey, Inc., New York, announced the appointment of J. W. Kreuttner to the general sales department. Mr. Kreuttner was formerly vice president and general manager of Air & Refrigeration Corp.

NEW ENGINEERING LABORATORY FOR PRINCETON

Construction of the James E. Hayes Engineering Laboratory has been approved by the Board of Trustees of Princeton University, Princeton, N. J. Excavation work has already been started and it is expected that the new building will be completed in September 1951. The new building will be of brick and will extend east from the south wing of the present John C. Green Engineering Building. Two-thirds of the building will be devoted to an instruction machine shop and a maintenance machine shop, and one-third will be used as an introductory mechanical engineering laboratory.

When completed the new building, plus the present machine shop area which constitutes the central section of the main engineering building, will be devoted to mechanical engineering.

E. A. KNAB RECEIVES AWARD

E. A. Knab, president of The Knab Co., Milwaukee, Wis., received one of the top awards in a nationwide merchandising contest sponsored by *Domestic Engineering*, Chicago. The judges who selected the winners were: H. C. Angster, executive secretary, *National Association of Domestic and Farm Pump Manufacturers;* F. B. Hout, vice president, Barnes Manufacturing Co., C. A. Ferguson, president, Noland Co., R. E. Ferry, general manager of the *Institute of Boiler and Radiator Manufacturers*, N. J. Radder, secretary, Plumbing and Heating Industries Bureau; C. S. Rambo, secretary, *Central Supply Association;* A. L. Scaife, merchandising manager of traffic appliances, General Electric Co.; C. A. Potts, vice president of U. S. Machine Corp. and president of the *Stoker Manufacturers Association;* A. T. Atwill, president of Quaker Manufacturing Co. and president of *Oil-Heat Institute of America;* C. A. Reinbolt, Jr., sales promotion manager of American Central Division, Avco Mfg. Corp; and R. L. Towne, sales manager for Rheem Manufacturing Corp.

E. A. Knab established his heating and plumbing business in 1920 and his sons, James and Daniel, are now partners of the firm.

E. A. Knab
Milwaukee, Wis.

Summary of Chapter Meetings

MIAMI VALLEY CHAPTER HOLDS CHARTER MEETING

The charter meeting of the Miami Valley Chapter of ASHVE started with dinner at 6:30 p.m. in the headquarters of the Engineering Society of Dayton, October 23 with an attendance of nearly a 100 members and guests. At the conclusion of dinner, Pres. C. D. Weaver, Jr. welcomed the group and presented A. E. Stacey, Jr., Syracuse, N. Y., past president of the Society, who presented the charter to the new Miami Valley Chapter on behalf of the Council of the Society. Mr. Stacey briefly reviewed some of the milestones in the Society's progress, mentioning that the gathering of this inaugural meeting exceeded the attendance of the first ASHVE meeting in 1895. He congratulated the group on organizing the 44th Chapter. Mr. Weaver thanked Mr. Stacey on behalf of the Chapter and then read some of the congratulatory messages received from Officers, Council members and other Chapters of the Society.

H. E. Sproull, member of Council from Cincinnati, presented the chapter with record books for the use of the secretary and treasurer and expressed the Council's hope that the chapter would grow rapidly and be a factor in the engineering activities of Dayton. President Weaver introduced F. H. McCormack, president of the Dayton Engineering Society, who welcomed the new chapter to Dayton and extended best wishes for its success.

M. J. Gibbons, Life Member of the Society from Dayton, felt that the organization of the Chapter was a worthwhile activity and he reviewed some of the early days of the Society's existence and told of the amazing progress of the profession since he entered the field of heating, ventilating and air conditioning. Brother Weber of the University of Dayton expressed his pleasure that the Chapter was organized in Dayton and hoped that there would be an opportunity for a Student Branch at the University.

All of the members and guests present were asked to stand and identify themselves and it was notable that a large delegation from the Cincinnati Chapter was present.

R. C. Allen, chairman of the program committee, presented Lester T. Avery, Cleveland, president of the Society, who spoke on *Dynamic Air Conditioning*. In his introduction Mr. Avery said that the growth of the Society to its present total of 8,241 was tied up with the progress of Chapters and he paid tribute to the men who had made the Society an outstanding organization in the engineering field. He said that the older members have something to give to the younger men and that there was great satisfaction from active participation in the work of the Society. He felt that it had a great hold on its membership and there was evidence of this in the interest taken by members as long as they remained on the Rolls.

Mr. Avery described the importance of air and its relationship to man and pointed out that while air is taken for granted it is under intensive study by scientists in many fields. With the aid of slides, he presented some observations to emphasize the importance of air and its use in providing a pleasant and healthful environment for living and working. He also pointed out that the duty of the air conditioning engineer is to be concerned with the outside air pollution as well as making the conditions agreeable indoors.

He referred to the work of the Society in its own Laboratory and cooperative colleges where for many years problems dealing with the physiological concepts of air have been studied. He explained that the air conditioning engineer has a responsibility to use the available tools to provide the conditions which are recognized as desirable, to study and use the important data developed by the Society and thereby maintain a proper place in a great profession, a great industry and a great Society.

Following his talk Mr. Avery answered a number of questions asked by members of the audience and a special vote of thanks was extended to him for presenting a most interesting subject.

• *ATLANTA*—October 9, 1950. After a social hour and dinner held at Harris Tea Room, the president, W. M. Garrard, called the meeting to order. The minutes of the September meeting were read and approved as read. A report was made by F. A. Player of the program committee who stated that a program had already been arranged for the November and December meetings, including a speaker from the National Bureau of Welding for the December meeting. The president then appointed two committees as follows: *chapter by-laws*—C. Boynton Cole, *chairman*, H. King McCain, and S. W. Boyd, *nominating*—W. J. McKinney, *chairman*, L. L. Barnes, and F. W. Bull.

A movie was then shown, through the courtesy of the Aluminum Company of America, and outlined in story form the production of and uses for aluminum. Attendance 30.

• *BALTIMORE*—October 18, 1950. Following dinner at 6:30 p.m. at the Engineers Club, Pres. G. B. Priester called the business meeting to order. After the introduction of guests was made, W. P. Flanigan introduced the speaker of the evening, Carl F. Boester, who gave an interesting talk on *High Temperature Hot Water Heating*. His subject covered principles, applications, and advantages in heating and processing systems used in Europe and in this country. Mr. Boester's description of his European trip and the contacts he made were very enlightening to his audience, according to the report of the secretary, N. L. Spinelli. The talk was

followed by an interesting question and answer period and refreshments. Attendance 54. Attendance ratio 0.56*.

• *CENTRAL NEW YORK*—October 12, 1950. Pres. A. L. Jones opened the meeting at the University Club at 8:00 p.m., following a social hour and dinner. After the introduction of guests, among whom were included officers of various engineering societies, V. S. Day, past president of the Chapter, introduced Lester T. Avery, president of the Society and president of Avery Engineering Co., Cleveland, Ohio. Mr. Avery described results of tests outlining the limits of air temperatures and the effect of air on the human being. He also showed slides describing various installations of air control equipment in factories and other buildings. Following his talk, Mr. Avery presented Mr. Day with a past president's pin for 1949-50.

In memoriam of two Society Past Presidents, Dr. Willis H. Carrier and William H. Driscoll, the following resolution, prepared by L. L. Lewis, was presented:

As the years roll by, members of ASHVE come and go.

WHEN they pass on, reflection reveals the expected — that most of them were the kind of good members who form the solid substance of the Society — that a few of them were the rare exceptions — great men and great leaders.

JUST exactly what it was that made these men great does not matter too much. The pertinent point for this occasion is that as we look back upon their lives we find that their leadership has left us examples and responsibilities.

ONE example is that whether their achievements have been in science or in building or in other fields, they made them greater by their unselfish interest in young people — by encouraging young people to develop and to grow — by not lifting themselves up by pressing others down.

ONE responsibility which they have passed on to us, is to carry on — each to the limit of his own capacity regardless of whether it be large or small.

MY task tonight is to single out two great men, Willis H. Carrier and William H. Driscoll — both so recently called to rest — respectively known to the more fortunate among us as the "Chief" and "Bill."

SINCE these two spent their lives in our field of endeavor, let us recognize our responsibility to carry on. Since one of the main objectives of our Society is to help the youngster to perform better services and to find greater opportunities, let us resolve to follow the examples that have been set.

ACCORDINGLY, and in behalf of the officers of the Central New York Chapter, I request that we show our recognition and our respect by standing for a moment of silence.

• *CENTRAL OHIO*—October 16, 1950. Pres. H. G. Hays called the meeting to order at 7:00 p.m., after chapter members and guests had had an enjoyable dinner at the University Club. The minutes of the September meeting were read and approved.

The chapter then heard from A. D. Bogen, Fred Gurley and R. A. Sherman, each of whom presented a brief sketch on his life and experience in the engineering field.

President Hays then introduced Marion Packard, who gave an interesting talk on *Climate Control Around Columbus*, stressing the various parts the elements play in human comfort. This was followed by the showing of pictures on the Cleveland Browns 1949 season by Mr. Bogen. Attendance 25. Attendance ratio 0.28.

• *CENTRAL OHIO*—September 18, 1950. The meeting was called to order at 8:00 p.m. at the Grandview Inn by Pres. H. G. Hays and the minutes of the May meeting were read and approved.

Three chapter members, W. M. Myler, Jr., M. McG. Swepston and H. R. Allonier, gave brief sketches of their lives and experiences in their individual fields. D. D. Piper introduced Sgt. Smith and Officer Ray of the State Highway Patrol, who gave an interesting talk on *Jujitsu and Gun Hold Breaks*.

Messrs. Burgess and Stein of Standard Oil Co. showed a sound movie on drilling and refining of oil. Attendance 27. Attendance ratio 0.22.

• *CINCINNATI*—October 3, 1950. After the meeting was called to order by Pres. E. W. McNamee at Engineering Society Headquarters, the minutes of the September 21 meeting were read and approved. H. E. Sproull reported on the Society's Semi-Annual Meeting in Muskoka and called attention to the forthcoming 1951 Annual Meeting in Philadelphia in January and the 1951 Semi-Annual Meeting, which will be held in Portland in July. President McNamee then announced that Mr. Sproull is a nominee for treasurer of the Society for 1951.

Howard E. Sproull
Cincinnati, Ohio

which announcement was received with enthusiasm by the chapter members.

R. C. Beineke introduced the speaker, G. F. Landgraf, vice president in charge of engineering, Trion, Inc., Pittsburgh, Pa., who gave an interesting talk on electrostatic precipitation from its origin to the present day installations. An interesting discussion period followed. Attendance 15. Attendance ratio 0.15.

• *CONNECTICUT*—September 26, 1950. Previous to the business meeting, the members and guests made a tour of inspection of the Connecticut Coke Co., New Haven. The guests were taken in groups of approximately ten and the entire process of coke manufacturing and its by-products was shown and explained in detail to all those making the trip.

*Note: The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

The business meeting was called to order by Pres. D. M. Hummel at Fitzgeralds' Restaurant and was followed by the reading and approval of the minutes of the June meeting.

R. J. Lorenzi, program chairman, introduced the speakers of the evening, Steven LeRoy and Edward Flahive of the Connecticut Coke Co., who spoke on coke chemicals and their use in industry and the process of making coke by blending five coals, also the storage and distribution of water gas coke and its by-products. Attendance 40.

• *DELTA*—October 10, 1950. Members and guests met in the Trophy Room of the New Orleans Athletic Club and Pres. Ralph Elizardi called the meeting to order at 7:10 p.m. The minutes of the meeting on September 12 were read and approved. It was voted that a committee should be appointed to work out the details for having a joint meeting with the Shreveport Chapter. The committee was appointed and requested to report at the next meeting.

G. C. Kerr then introduced the speaker of the evening, Dr. J. C. Morris, head of the Department of Physics and vice president of Tulane University. Dr. Morris' subject was *Some Intangible Weapons for Defense*, and after his talk he answered many questions from the audience. Attendance 38. Attendance ratio 0.30.

• *GOLDEN GATE*—October 5, 1950. J. E. Murray, member of the Golden Gate Chapter's board of governors, was the presiding officer in Pres. K. F. Baldwin's absence due to sickness. The introduction of guests and the roll call of members, was followed by the reading of the minutes of the September 7 meeting. Reports were made by H. R. Scandrett, chairman of the finance committee, and T. C. Douglass, Jr., chairman of the reception committee. Mr. Murray announced the appointment of the nominating committee as follows: H. V. Hickman, *chairman*; G. M. Simonson and Eric Roberts.

An interesting and instructive talk on *Warm Air Panel Heating* was given by Art Staat of the Natural Gas Equipment Co. Mr. Staat's talk was illustrated by the use of slides. Attendance 80.

• *ILLINOIS*—October 9, 1950. After the meeting was officially opened by Pres. P. J. Marschall, H. G. Gragg, membership chairman, introduced the new members. President Marschall announced that it was decided that the Illinois Chapter should affiliate with the Illinois Engineering Council. John W. James introduced S. R. Lewis, who presented Life Membership Certificates to F. H. Gaylord and L. D. Emmert.

C. A. Gustafson, chairman of the meeting, introduced the speaker, J. R. Vernon, assistant secretary and sales promotion manager, Johnson Service Co., Milwaukee, Wis., who spoke on *Effectiveness of Proper Control for Air Conditioning*. He pointed out that air conditioning is a means of accomplishing a physiological effect. Normally, heat generated within the human body maintains the body temperature above that of the surrounding air so that heat is lost from the body by convection, radiation and evaporation, stated Mr. Vernon. He declared that air conditioning permits body heat production to be balanced by heat loss.

Limiting much of his talk to control systems where individual room controls are used in conjunction with master controls, Mr. Vernon used slides to show basic hook-ups for bellows, disc, and bimetal thermostats. In discussing thermostats of the bulb and capillary tubing type, he explained the difficulties encountered with the vapor tension thermal system, showed how the gas filled system is an improvement, and stated that the liquid filled system is the easiest to calibrate and to compensate for temperature effects on the tubing.

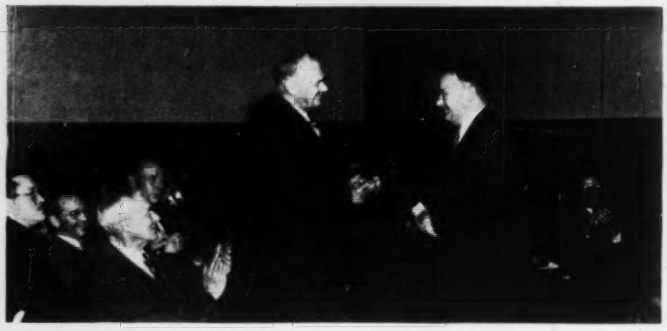
Control systems were broadly classified as to direction of action (direct or reverse acting) and as to type of action (two-position or proportional). It was shown that an over-sensitive controller can give very poor results, as can an undersensitive controller. The cure for the latter was said to be an instrument which permits sensitivity adjustment, and Mr. Vernon showed how the sensitivity of various controls may be changed. In his opinion, the proportional action type of instrument with sensitivity control and automatic reset is making air conditioning controls extremely effective. Attendance 125.

• *KANSAS CITY*—October 2, 1950. Members and guests met at the Roof Garden of the Aladdin Hotel and Pres. W. E. Howarth called the meeting to order at 7:30 p.m. After the reading of the minutes of the September 12 meeting, which were approved as read, T. I. Harriman, chairman of the student chapter relations committee, introduced Prof. W. E. Snyder, new chairman of the Department of Mechanical Engineering, University of Kansas.

Ernest Szekely
Milwaukee, Wis.

D. M. Allen, member of Council, discussed the activity of the Society's Council in regard to their long range research program, state registration of individual chapters, and new By-Laws.

Mr. Allen then introduced the guest speaker, Ernest Szekely, second vice president of ASHVE and president, Bayley Blower Co., Milwaukee, Wis., who gave an interesting and informative talk on *Fans—Their Design and Application*. Mr. Szekely used slides to illustrate his talk. Attendance 59. Attendance ratio 0.24.



Dean Seeley congratulating Coll T. Flint on his election to Life Membership

• *MASSACHUSETTS*—October 17, 1950. A social hour and dinner was held in the Campus Room of the MIT Graduate House at 5:30 p.m. preceding the meeting. Pres. D. W. Blair called the meeting to order at 7:30 p.m., and announced the appointment of the following committee chairmen: *program*—John Bonner; *membership*—D. C. Miller; *social*—L. R. Geissenhainer; *technical advisory*—F. A. Merrill; *finance*—C. H. Dow; *legislative*—R. T. Kern; *public relations*—G. D. Mayes; *research*—A. L. Hesselschwerdt, Jr.; *hospitality*—H. L. VonRehberg; and *attendance*—I. S. Dane.

L. E. Seeley, dean, College of Technology, University of New Hampshire, Durham, and first vice president of the Society, presented Coll T. Flint with a Life Membership Certificate in the Society.

Mr. Bonner introduced the speaker, Carl F. Boester, housing consultant, Purdue Research Foundation, Purdue University, W. Lafayette, Ind., who spoke on *New Practices in High Temperature Forced-Hot-Water Heating*. Mr. Boester stated that he had recently completed a tour through England, Holland, France and Switzerland to investigate this type of heating, which has been used for a time in these foreign countries. He described installations in housing projects and institutions in several large cities which have extensive hot water district heating systems. He stated that there are a few installations in this country and considerable interest has been shown by engineers and architects in its future use. Mr. Boester used slides to illustrate his talk.

After a short discussion period, Mr. Boester was extended a rising vote of thanks for his interesting and informative presentation. Attendance 91. Attendance ratio 0.55.

• *MICHIGAN*—October 16, 1950. Eighty members were present at the dinner, which preceded the business meeting, and since this first meeting of the season was designated as *Get Acquainted Night*, each person was asked to introduce the person sitting directly next to him.

The speaker of the evening, C. S. Leopold, consulting engineer of Philadelphia, Pa., was introduced by G. W. Akers, vice president of the Chapter and the program chairman. Mr. Leopold spoke on *Internal Energy Release Effect in Conventional and Panel Cooling Systems* or *Why Under Capacity Jobs Sometimes Work*. Mr. Leopold's comprehensive presentation, which was supplemented by slides, covered essentially the following items:

1. Radiation factor as it affects cooling calculations in large buildings and some common errors which might occur by using standard formulae which do not take all factors into account.
2. The immense storage capacity of large buildings for both heating and cooling, specifically cooling, however, and the possible way to make use of this in assisting the cooling capacity.
3. The actual application of some large jobs employing the principle of panel cooling both in ceiling and side wall panels.

C. S. Leopold
Philadelphia, Pa.

After a question and answer period a vote of thanks was extended to Mr. Leopold. Attendance 95.

• *MINNESOTA*—October 2, 1950. Members and guests met in the Country Garden Room of the Dyckman Hotel and the business meeting was opened at 8:00 p.m. by Pres. G. M. Kendrick and the minutes of the May meeting were read and approved. During the dinner which preceded the business meeting, H. K. Johnson introduced the Phillip C. Schmitt Quartette, who entertained the chapter members with five excellent selections.

E. F. Snyder, Jr., vice president of the chapter, introduced the speaker of the evening, Paul Crumish, field ventilation engineer, Joy Manufacturing Co., Chicago, Ill., who gave an interesting talk on *Vaneaxial Fans*. He also presented a colored, sound movie to illustrate his talk. A discussion period followed. Attendance 113. Attendance ratio 0.33.

• *NEBRASKA*—October 10, 1950. Pres. G. W. Colburn was the presiding officer and called the meeting to order at 6:30 p.m. at the Hotel Castle, Omaha. The speaker of the evening was Carl F. Boester, housing consultant, Purdue Research Foundation, Purdue University, who spoke on *New Practice in High Temperature Forced-Hot-Water Heating*. Mr. Boester gave an interesting talk and description of several installations he had visited on his recent trip

Carl F. Boester
Lafayette, Ind.

to Europe. Of particular interest, was his description of the new high temperature forced-hot-water heating system now being installed in Buckingham Palace. Attendance 40. Attendance ratio 0.34.

• *NEW YORK*—October 16, 1950. Following a social hour and dinner, the meeting was called to order by Pres. Carl F. Kayan in the Building Trades Club. President Kayan extended greetings to the members and guests and outlined the plans for chapter programs for the coming season. The introduction of the officers and board of governors for the coming season was followed by the reading and approval of the minutes of the May 15 meeting. H. S. Johnson, president of the New York Chapter in 1949-50, was presented with a plaque in recognition of his services on various chapter committees and as president of the chapter. A. V. Hutchinson, executive secretary of the Society, gave a brief review of the plans for the coming Annual Meeting in Philadelphia, January 22-25, 1951.

President Kayan introduced the new program chairman, J. B. Hewett, who presented the guest speaker, P. L. Davidson, consulting engineer, Philadelphia. Mr. Davidson spoke on the subject, *Industrial Air Conditioning*, stating:

> There is never a dull moment in the life of an engineer who designs air conditioning systems for the textile industry. He can expect that just when he has a design finished, the owner will have decided to move the machinery and shift production because of changes in demand for certain kinds of product. This might tend to discourage beginners in design but it would soon be discovered that manufacturers who have the best success are those who are able to adapt their processes to the customer's taste very quickly.
>
> Air conditioning in industry was first used in the textile industry because the demand for controlled humidity and temperature was so well recognized.
>
> Elements of load on textile air conditioning systems were mentioned. An idea of possible heat loads from machinery was obtained from the heat output of double-deck yarn twisting machines which, when placed 4 feet on centers, produced a heat output of 230 Btu per square foot of floor space per hour.
>
> The necessity of electrostatic air cleaners was explained by the importance of keeping the dust in outside air from reaching the product being manufactured.

Mr. Davidson answered questions from the audience and was able to provide much interesting information based upon his experience. The meeting was adjourned at 9:30 p.m. after extending the speaker a rising vote of thanks for a very informative and interesting session. Attendance 110.

• *NORTH TEXAS*—September 18, 1950. Members and guests introduced themselves after Pres. Herman Blum opened the meeting at 8:00 p.m. in the Melrose Hotel. The minutes of the previous meeting were read and approved, which was followed by the reading of the amendment to the chapter by-laws.

President Blum then introduced the guest speaker of the evening, M. W. Brown, field engineer, American Blower Corp., Dallas, who enlightened his audience by stating that there was more construction done in Texas in 1948 and 1949 than anywhere else in the United States. He stated that 20 percent of the total construction in the United States was done in Texas. Mr. Brown discussed various types and applications of fans and suggested that each engineer familiarize himself with the terminology of the *Fan Manufacturers Association*. After Mr. Brown's full coverage of the industrial and air conditioning fan field, the meeting was opened for discussion. Attendance 70. Attendance ratio 0.36.

• *NORTHEASTERN OKLAHOMA*—October 10, 1950. The business meeting, which was called to order by R. F. Shoemaker, vice president of the chapter, was preceded by a dinner at Smith's Restaurant at 6:30 p.m. The secretary read the minutes of the September 12 meeting, which were approved as read. F. M. Thomas announced the Oklahoma A & M Student Branch had invited the chapter members to a dinner which is to be held after the Oklahoma A & M homecoming game.

B. F. Purifoy introduced the speaker of the evening, W. S. Harris, special research associate professor, University of Illinois, Urbana, who gave a very interesting presentation on *Radiant Baseboard Heating*. Professor Harris' talk was followed by a discussion period, which was followed by adjournment. Attendance 19. Attendance ratio 0.45.

• *NORTHEASTERN OKLAHOMA*—September 12, 1950. Pres. A. D. Holmes officially opened the business meeting at 7:30 p.m., at which time the roll was called. The secretary read the minutes of the previous meeting, which were approved as read. Member hosts introduced their guests after which the program

Season's Greetings

and Don't Forget —

YOU have a date for

January 22-25!! Turn to p. 128

JOURNAL SECTION

Linn Helander
Manhattan, Kans.

chairman reviewed the programs for the coming months.

C. H. Dollmeyer introduced the speaker of the evening, Prof. Linn Helander, head, Department of Mechanical Engineering, Kansas State College, Manhattan, Kans. Professor Helander's subject was *Downward Projection of Heated Air*. After a thorough discussion of the subject the meeting was adjourned. Attendance 23. Attendance ratio 0.12.

• *NORTHERN OHIO*—October 9, 1950. Pres. W. M. Rowe opened the meeting and the minutes of the September 22 meeting were read. President Rowe then introduced the chairmen of the following committees: publicity, membership, meetings, and program. Each chairman gave a brief report of the activities of his group and asked the members to support the work when their services were requested.

Lester T. Avery, president of ASHVE and president of Avery Engineering Co., Cleveland, addressed the chapter briefly. He announced the recent deaths of W. H. Driscoll and of Dr. W. H. Carrier and praised them for the outstanding services which they rendered to the Society. Mr. Avery mentioned that the addition of the Miami Valley Chapter in Dayton brings the number of active chapters in Ohio up to four, making Ohio the leader in the number of active chapters. He spoke briefly on the activities of the Chapter Relations Committee and called attention to the fact that the 1951 Exposition, which is to be held in conjunction with the forthcoming Annual Meeting in Philadelphia, would be the last until 1953.

The meeting was then turned over to L. C. Burkes, who introduced the speaker of the evening, Harry Zankey, vice president and chief engineer, Pittsburgh Lectrodryer Corp. Mr. Zankey spoke on the subject, *The Ocean of Air in Which We Live*, tracing the history of our understanding of air and its characteristics from 1600 to the present time. His talk was illustrated with slides and an interesting discussion followed. Attendance 61.

• *ONTARIO*—October 5, 1950. Dinner at the Royal York Hotel at 6:00 p.m., was followed by the business meeting, which was called to order by Pres. J. H. Fox at 7:00 p.m. President Fox announced that since the last chapter meeting, the chapter had lost three of its valued members due to death, namely, W. E. Goodram, W. F. Graham and Robert McHendry. An announcement was made by President Fox concerning the approval by Council of a student branch to be organized at the University of Toronto, which will be headed by Prof. F. G. Ewens. He also spoke briefly on the Society's Semi-Annual Meeting in Muskoka.

The speaker of the evening was G. M. Bray, sales manager of A. P. Green Brick Co., Ltd., Weston, Ont., Canada, who gave an illustrated talk on *Mother Earth and Her Cupboard*. Mr. Bray's talk dealt principally with with the mining and manufacture of clay in the manufacture of firebrick, mortar lining, etc. Attendance 87. Attendance ratio 0.35.

• *OREGON*—October 5, 1950. After calling the meeting to order in the Old Heathman Hotel, Pres. R. C. Chewning called for the reading of the minutes of the previous meeting, which were approved. Reports were made by the following: W. A. Simpson—membership committee, J. H. Bonebrake—finance committee, J. S. Bowen, Jr.—student branch committee, and B. M. Thornburg—social committee. B. W. Farnes,

Arthur J. Hess
Los Angeles, Calif.

general chairman of the 1951 Semi-Annual Meeting, which is to be held in Portland, spoke briefly on plans concerning the meeting.

The meeting was then turned over to T. C. Langdon, the treasurer, who introduced the speaker of the evening, A. J. Hess, member-owner, Hess-Greiner & Polland, Los Angeles, Calif., who spoke on *Air Conditioning a Phytotron*. Mr. Hess touched on the comparatively pre-historic methods that are still used in so-called modern agriculture. He reacquainted his audience with many forgotten phytogenetical facts and presented them with innumerable new evidences that pointed out the extreme importance of temperature and humidity in the controlled growth of practically all plants. Many new thoughts were introduced to whet the minds of his audience, which was amply demonstrated by the number and variety of questions answered by Mr. Hess at the close of his address. Attendance 62.

• *PHILADELPHIA*—October 12, 1950. The meeting was called to order by Pres. J. W. McElgin at the Engineers' Club at 7:50 p.m. and the minutes of the June meeting were read and approved. After the reading and approval of the treasurer's report, E. K. Wagner introduced two newly elected members of the Chapter, R. A. Metz, Jr. and R. A. Furniss. President McElgin announced the death of Dr. W. H. Carrier and W. H. Driscoll, both Society Past Presidents, and requested that the audience stand and pay respects in a moment of silent prayer.

A framed Life Membership Certificate was presented to A. E. Kriebel by M. F. Blankin and to S. E. Plewes by C. S. Leopold. Mr. Leopold announced that Life Membership Certificates had also been awarded to H. P. Gant and E. R. Sabin, though neither could attend the meeting.

M. E. Barnard, chairman of the meetings committee, then introduced O. C. Lewis, district engineer, Layne New York Co., who gave a very interesting address on *The Ground Water Situation in the United States*, followed by a Kodachrome moving picture. An extended discussion followed Mr. Lewis' address.

• *PITTSBURGH*—October 13, 1950. This was a combined dinner and business meeting of the ASHVE and the *ASRE*, held in the Marine Room of the Roosevelt Hotel. Since the speaker for the evening had another engagement, immediately following the dinner Dr. Ludwig Adam, vice chairman of the *ASRE* introduced Paul Martin, executor director, Allegheny Conference on Community Development. Mr. Adam's subject was *Greater Pittsburgh*. He spoke of what the committee had tried to accomplish and to what extent it had developed, mentioning that it was exciting to see new skyscrapers go up in the Triangle, to be able to wear a white shirt, and to see so many new industries pop up in the last year. He indicated that projects like this took a lot of careful planning and hard work on the part of an organization created for this purpose. Mr. Adam said that it was amazing the number of projects that have yet to be started and the work which will be required to finish them. Mr. Adam's talk was well received and brought out many interesting points.

Following Mr. Adam's talk, there were introductions of the officers and members of each section.

A report was given on the golf meet held in June at the Edgewood Country Club for the Walker Trophy. In the tournament the ASHVE team won the cup for the second time and if they win again next year they will retain possession of the cup permanently. Attendance 50.

• *ST. LOUIS*—September 12, 1950. Pres. J. S. Rosebrough called the meeting to order at 8:15 p.m. in the Westborough Country Club and the minutes of the May 2 meeting were approved as read. Mr. Rosebrough extended a welcome to the wives of the members for the Annual Ladies Night. Reports were made by the following: J. B. Killebrew—membership committee, C. H. Burnap—meetings committee, and B. C. Simons—finance and auditing committee.

After a brief recess, the meeting was convened at 9:00 p.m. at which time Mr. Burnap introduced John Kennish of the Southwestern Bell Telephone Co., who gave an interesting talk on safety in the home and stressed the point that most accidents were due to carelessness.

E. E. Carlson related some of his experiences while fishing in the fast waters of Missouri. He also spoke of the beauties of the Missouri Ozarks and commented that if the proposed dams were built, the majority of the beauty would be destroyed. Attendance 70.

• *SHREVEPORT*—October 19, 1950. After social hour and dinner, Pres. B. E. Segall, Jr. called the meeting to order at the Caddo Hotel and the first order of business was the appointment of the nominating committee for the year 1951 as follows: Messrs. FitzGerald, Haas, Segall, Rottmann and Otto. It was announced that the speaker for the November meeting would be Lester T. Avery, president of the Society, and it was moved and seconded that this meeting would be Ladies Night.

R. L. Patton introduced the guest speaker of the evening, V. D. Wissmiller, supervisor, Minneapolis-Honeywell Regulator Co., Minneapolis, who gave an interesting talk on *Solar Heating of Residences*. Attendance 35.

• *SHREVEPORT*—September 21, 1950. Members and guests met at the Caddo Hotel for a social hour and dinner, followed by the business meeting which was called to order by Pres. B. E. Segall, Jr. President Segall introduced Walter Cooke of the Delta Chapter, who proposed a state wide meeting of the members of the ASHVE. It was moved that the Shreveport Chapter participate in this meeting and the following committee was appointed: A. H. Otto, *chairman*; R. M. Hood, R. L. Patton and J. L. Collins, Jr.

ASHVE and *ASRE* members in St. Louis relax after golf tournament; trophy shown in foreground.

(l. to r.) E. H. Riesmeyer, Jr., captain of ASHVE St. Louis Chapter team, Leroy Walker, donor of the cup, and Art Brown, captain of *ASRE* team.

Donald Attaway, safety director of the Arkansas Fuel Oil Co. gave a brief and interesting talk on *The Formula of the Value of a Committee.* This was followed by an informative talk on *Vacuum Pumps and Steam Systems,* by D. W. Whittington, president, Whittington Pump and Engineering Corp., Indianapolis, Ind. Attendance 40.

• *SOUTH TEXAS*—October 20, 1950. Pres. H. W. Broadwell called the meeting to order at Bill Williams Restaurant at 8:00 p.m. and the minutes of the preceding meeting were read and approved. Reports were made by J. C. Lewis, chairman of the membership committee and A. A. Rasmussen, chairman of the research committee, which was followed by a report from the treasurer, E. G. Floeter. A motion was passed that the South Texas Chapter reduce the price of dinner for any engineering students attending the meetings and that the balance would be paid for out of the chapter treasury.

E. J. Stern, district manager, Armstrong Cork Co., Dallas, was introduced by J. W. Holland. Mr. Stern spoke on *Proper Selection and Application of Insulating Materials for Air Conditioning Systems,* and showed a movie film on the penetration of air and moisture through brick walls as a result of wind velocity. A number of charts were displayed and many samples of various types of insulators. Attendance 62. Attendance ratio 0.28.

• *SOUTHERN CALIFORNIA*—September 20, 1950. Dinner at the Conde French Restaurant, Beverly Hills, preceded the business meeting, which was called to order by Pres. L. J. Helms. President Helms reported on the programs as outlined for the meetings of the coming year.

The scheduled speaker of the meeting was E. S. Hamilton, senior engineer of Ralph M. Parsons Co., who intended to speak on the subject of *Design of Mechanical Equipment for the Atomic Energy Commission at Los Alamos.* Mr. Hamilton, along with J. L. McCullough, the program chairman, explained that they had previously had a clearance from the Atomic Energy Commission for Mr. Hamilton's presentation, but that morning had received a telegram rescinding this clearance. C. N. O'Day, president, Air Devices, Inc., New York, N.Y., was introduced and graciously presented an informal and impromptu talk on his many years of experience in the field of heating, ventilating and air conditioning and his findings on the importance of complete understanding and cooperation of all phases of the industry. Following Mr. O'Day's talk a short discussion period was conducted. Attendance 80.

• *VIRGINIA*—October 18, 1950. After calling the meeting to order Pres. W. P. Robinson welcomed the guests and called for the reading of the minutes of the September meeting. The election of the nominating committee for the coming year followed, with the following results: J. F. Reynolds, chairman, E. D. Duval, J. E. White, F. R. Ervin and Laurence Trant.

Mr. White announced the speaker for the November meeting and called upon M. I. Taylor to introduce L. S. Oosten, assistant chief engineer, Bell & Gossett Co., Morton Grove, Ill. Mr. Oosten's subject was *Application of Centrifugal Pumps to Hot Water Heating Systems.* He told of the many conditions for selecting pumps, including the temperature drop required and friction losses, and stated that sometimes friction losses were figured three ways, constant friction loss, additive friction loss and constant velocity. He pointed out that in many cases centrifugal pumps have been selected which are several times larger than necessary. These pumps cause high velocity in the pipes and sometimes give noise trouble. He recommended that for pipe sizes 1/2 in. to 4 in. IPS, that 4 fps velocity be the maximum. He illustrated his talk with slides showing the relation of flow to friction loss, typical pump capacity chart, and sketches of a piping design example. After an interesting discussion, the meeting was adjourned. Attendance 33. Attendance ratio 0.53.

• *VIRGINIA*—September 20, 1950. Pres. W. P. Robinson called the meeting to order, and the minutes of the May meeting were read. The secretary read a letter from A. V. Hutchinson, executive secretary of the Society, regarding revisions in the chapter by-laws. The suggested changes were accepted by the chapter. J. F. Boyenton and J. E. White were elected the Virginia Chapter's member and alternate member on the Chapters Conference Committee.

Mr. White introduced the speaker, D. C. Delinger, representative, Minneapolis-Honeywell Regulator Co., Norfolk, who spoke on *Control of Central Fan Heating Systems.* Mr. Delinger illustrated several heating control systems, using different types of controls, modulating steam valves, modulating damper controls, etc., describing their advantages and disadvantages. He sized a modulating steam valve and made several recommendations, and closed with a demonstration illustrating the sensitivity of electronic controls. Attendance 15. Attendance ratio 0.47.

• *WASHINGTON, D. C.*—October 11, 1950. The meeting was called to order by Pres. F. M. Thuney in the private dining room of Naylor's Seafood Restaurant and President Thuney congratulated J. L. Manheim, chairman of the attendance committee, on the outstanding job he and his committee did in getting out the members for the first meeting of the season. The minutes of the May meeting were read and approved as read and S. R. Allen, chairman of the meetings committee, reported that the January meeting would be held jointly with the *ASRE* in Baltimore. President Thuney announced the creation of a committee of past presidents of the Washington, D.C. Chapter, who would serve as a nominating committee. The committee consists of the following past presidents: P. R. Achenbach,

A. S. Gates, and H. H. Hill. President Thuney, alternate member for the Washington, D. C. Chapter on the Chapters Conference Committee, called attention to the forthcoming Annual Meeting in Philadelphia in January 1951 and added that any suggestions from chapter members regarding improving the Society and its chapters in making them function more efficiently would be welcomed. A number of suggestions were received.

The meeting was then turned over to S. R. Allen, who introduced Ernest Szekely, Milwaukee, second vice president of the Society and president of Bayley Blower Co., who spoke on *Fans — Their Design and Application*. Mr. Szekely started off by giving the terminology of fans, stating that the names applied to the different types of fans were uniform so that when a certain term was applied to a fan every fan manfacturer would know exactly what was meant.

He stated that all fans are classified according to the direction of air flow through the fan with relation to the axis or rotation, and are classified either as:

1. *Axial flow* or propeller type fans, where the air flow is parallel to the axis.
2. *Radial flow* or the centrifugal type of fan, where the air flow is at right angle to the axis.
   (*a*) *Forward sloped blades* for slow speed fans.
   (*b*) *Backward sloped blades* for higher speeds.

Mr. Szekely stated that today all fans are built out of steel plates and that the cast iron fan and the wooden fan are not in use any longer. He declared that designs of fans are limited by space and noise problems and that people seem to be extremely sensitive to noise in fans and since they are the purchasers, they must be designed according to their likes and dislikes. Failure of fans is due to two main causes: (1) mechanical trouble and (2) static pressure problems. Mr. Szekely added that quite often the fan alone is not to blame for failure, for it often fails to get the cooperation of the rest of the system. A number of slides were shown giving the operating characteristics of the various types of fans in the form of plotted curves and charts. Pictures were also shown on characteristic types.

Many questions were asked during the discussion period, indicating a lively interest in the subject. Attendance 84. Attendance ratio 0.74.

• *WESTERN MICHIGAN*—October 9, 1950. V. H. Hill, vice president, was the presiding officer and called the meeting to order, after dinner at the Poplars, East Lansing. F. W. Brundage, the secretary, read committee appointments for the year 1950-51 and it was announced that the November meeting would be set aside as Ladies Night and B. J. Walter urged the cooperation of the membership in insuring a large turnout.

The speaker of the evening, R. S. Dill, chief, Heat and Air Conditioning Section, National Bureau of Standards, Washington, D.C., was introduced by Mr. Hill. In his talk on *Research in Domestic Heating*, Mr. Dill covered the various research programs in many different laboratories in colleges and universities throughout the country. He stated that testing work is being conducted almost continuously on all types of heating and also on various methods of measuring heat flow through different types of materials. One instrument mentioned was the electric analogue, which he stated is being used to predict and analyze the flow of heat in a concrete building. He also mentioned that solar heating was being tried successfully, but that the collecting surface is too large and bulky, and probably would be objected to by the home owner. Other phases of air conditioning are continuously being investigated, among which are air-borne infections, humidification, sterilization, etc.

A question and answer period followed in which the secretary's report indicated that the greatest interest was shown in humidification, that is, the effect of too much and too little humidification in a structure. The proper method of placing vapor barriers in the wall and how to overcome condensation within a wall and also within a structure, were also discussed. Mr. Dill's talk was well received as indicated by the interest shown by the membership. Attendance 70.

• *WESTERN NEW YORK*—October 12, 1950. Chapter members were the guests of the American Radiator & Standard Sanitary Corp. for lunch in the cafeteria and a tour of the Bond plant. Phil White, manager of the plant, welcomed the members and explained the afternoon inspection trip. The members were separated into small groups and conducted through all phases of the plant including the foundry, machine, grinding, pattern, core making, inspection and assembly shops, and the stock and shipping departments. At the end of the tour, two small cast-iron boilers were assembled for the group illustrating the ease of installation due to the sub-assembly and packaging of the products of the Bond plant.

The group then convened to the University Club for dinner and the business meeting. Pres. J. H. Bryce turned the meeting over to C. A. Gifford, local sales representative for American Radiator & Standard Sanitary Corp., who introduced the members of the Bond and Stamping plants. Mr. Gifford introduced the speaker of the evening, H. C. Day, field engineer, American Radiator & Standard Sanitary Corp., Pittsburgh, Pa., and member of ASHVE, whose topic was *Boiler Man's Creed*. Mr. Day pointed out that personal contacts and integrity were paramount for salesmen, engineers and contractors. The heart of a home or every building is the heating system and all must strive to give quality and service, stated Mr. Day. He maintained that the key to success is to believe in yourself, people, industry and organization.

Mr. Gifford thanked Mr. Day and introduced Cal Hewitt, manager of the Buffalo Sales office of the American Radiator & Standard Sanitary Corp., who thanked the chapter for allowing American Radiator to be

their hosts for the day, and for the number of members who were present and for the interest shown. A standing vote of thanks was given by the chapter to the members of the corporation for their hospitality and entertainment for the day. Attendance 73.

Student Branches

▸ *PURDUE UNIVERSITY*—October 18, 1950. The meeting was opened by J. J. Harrell, chairman of the student branch, at 7:30 p.m. in the Mechanical Engineering Building. The minutes of the previous meeting were then read and approved. It was announced that the October meeting of the Indiana Chapter would be the annual *Professor Bill Miller Night* and that the guest speaker would, of course, be Professor Miller. Ten students were to be sent to represent the student branch.

The meeting was then turned over to I. W. Cotton, president, The I. W. Cotton Co., Inc., Indianapolis, Ind., who spoke on the physiological and psychological aspects of heating and ventilating. Mr. Cotton stressed the importance of comfort of the occupants in the space to be heated, stating that they must feel no drafts or dampness in the room. He advised dispensing with the thermometer at the thermostat, since this keeps people from adjusting the thermostat to what they think they need rather than what they feel. He gave various examples of the factors entering problems of heating. Attendance 20.

▸ *TEXAS A & M COLLEGE*—October 24, 1950. After the meeting was called to order in the Mechanical Engineering Lecture Room by Pres. J. O. Kadel and the self-introductions were made, the minutes of the previous meeting were read and approved as read. An invitation was extended to the Student Branch to attend the meeting of the *Texas Society of Professional Engineers* on October 27 in Bryan, Tex. It was announced that the Student Branch would meet

J. J. Harrell, chairman of Purdue University Student Branch and Prof. W. T. Miller of the University.

jointly with the *ASME* and *SAE* Student Branches on November 7. An announcement was made regarding the preparation of a paper on the *Value of Fellowships to the Student and to Industry* which is to be given on December 11, 1950 at the sixth Annual Southwest Air Conditioning Conference.

W. E. Weathersby, program chairman, introduced Mr. Hall who spoke on *The Professional Engineer*. Attendance 25. Attendance ratio 100.

▸ *TEXAS A & M COLLEGE*—October 10, 1950. The meeting was called to order by President Kadel in the Mechanical Engineering Lecture Room at 7:30 p.m. In accordance with the custom of the Student Branch, everyone present stood and introduced himself to the group. Messrs. Weathersby and Pendley were appointed to serve on the program committee as chairman and member, respectively.

Prof. L. S. O'Bannon gave a talk on the *Motives of the ASHVE*, including local membership and its advantages and the speakers made available to the Student Branch. Attendance 25. Attendance ratio 100.

▸ *UNIVERSITY OF KANSAS*—October 17, 1950. R. C. Umholtz, the secretary, called the meeting to order in Marvin Hall at 5:00 p.m. and the treasurer made a brief report. F. C. Boucher and R. A. Long were appointed to a special membership committee.

It was suggested that a joint meeting be held with the *ASME* and that the ASHVE provide the speaker. A tentative date was set for this meeting with the approval of the *ASME* representative, Wendell Johnson. Attendance 10. Attendance ratio 0.78.

▸ *UNIVERSITY OF TEXAS*—October 10, 1950. Acting President L. E. Scott called the meeting to order in the Engineering Building at 7:30 p.m., and called for self-introductions. Prof. W. E. Long, the branch sponsor, made a few introductory remarks concerning the history of the University of Texas Student Branch, and the numerous advantages to be had as a member of the ASHVE. Professor Long also asked the students to consider preparing a paper on the *Value of Fellowships to the Student and to Industry* to be given on December 11, 1950, at the sixth Annual Southwest Air Conditioning Conference. Attendance 16. Attendance ratio 0.44.

REFRIGERATING PRINCIPLES AND PRACTICES

by Norman Sharpe*

The purpose of the book is to assist the student in correlating the principles of refrigeration with the practices of the refrigerating industry. The subjects of the 10 chapters, which comprise the book, are: Chapters 1—The Refrigeration Load; 2—Properties of Refrigerants; 3—Refrigeration Cycles; 4—Compressors and Their Lubrication; 5—Heat-transfer Equipment; 6—The Expansion Valve and the Accumulator; 7—Accessories; 8—Piping for Refrigerating Systems; 9—Motors and Their Controls; and 10—

*Associate Member of ASHVE

Refrigeration Applications. There are also 6 appendixes as follows: Appendixes 1—Commercial Storage of Fruits and Vegetables; 2—Internal Energy of a Fluid; 3—Transferred Heat; 4—Pressure and Volume Relation for Adiabatic Compression; 5—Work Required for Adiabatic Compression; and 6—American Standard Safety Code for Mechanical Refrigeration.

Conditions affecting storage of various fruits, vegetables and other foods are given in several tables in Chapter 1.

The various commercial refrigerants are discussed in considerable detail and their properties are listed in 29 tables.

The operation of the various refrigeration cycles and equipment such as compressors (reciprocating, rotary, and centrifugal) are described in a simple manner. Special attention is given to lubrication of compressors. Heat transfer theory is discussed and formulas for heat transfer are developed after which the factors affecting heat transfer in different types of equipment such as spray chambers, cooling coils, cooling towers, condensers, evaporators, and brine coolers are considered.

Functions and operating characteristics of expansion valves, accumulators, and accessories are discussed in detail. The chapter on piping for refrigerating systems deals with suitability of materials for use with various refrigerants and friction data for sizing refrigerant piping. Characteristics of motors and factors affecting application to refrigeration machines are presented.

The chapter on Refrigeration Applications illustrates types of systems for cold storage warehouses, (including wall construction details), meat packing, locker storage and ice making.

The reader will find a combination of practical applications with principles of design and operation throughout the book. The book is published by McGraw-Hill Book Co. 327 W. 42nd St., New York City. The price is $4.00.

Candidates for Membership

The Society's By-Laws require that all applications for membership or advancement are to be sent to the Executive Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society, or mailed to all members. When the replies are received from references, the Candidate's application shall be submitted to and acted upon by the Admission and Advancement Committee as soon as possible.

When the Admission and Advancement Committee has acted favorably upon a Candidate's application and assigned his grade, the Council shall confirm the election of the proposed Candidate for membership. During the past month 110 applications for membership, including 36 student applications, 5 reinstatements; and 9 advancements have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Admission and Advancement Committee, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Executive Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by December 29, 1950, these candidates will be voted upon by the Council. Those elected to membership will be notified by the Executive Secretary immediately after election.

ARNESON, R. E., Design Engr., C. F. Braun & Co., Alhambra, Calif. REFERENCES: D. F. Dawson, T. T. Eyre*, J. A. Miller*, F. M. Patterson.

BARROW, T. A., JR., Sales Engr., Felix J. Commagere, Atlanta, Ga. REFERENCES: W. M. Garrard, E. K. Jamison, W. J. McKinney, F. A. Player.

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MCINTOSH, J. W., Htg. & Air Cond. Engr., American Radiator & Standard Sanitary Corp., Memphis, Tenn. REFERENCES: A. T. Bevil, O. A. Holmes, Jr., J. B. Lammons, E. E. Scott.

OBITUARIES

BERT C. DAVIS
Elmira, N. Y.

The Society has just been informed of the death of Bert C. Davis, Life Member of the Society since 1937, on October 14 at the age of 79. Mr. Davis was born on November 21, 1871, in Humboldt, Nebr.

He served his apprenticeship with W. R. Parsons Co., architects in Des Moines, Ia. and also received his drafting experience with the company. Mr. Davis was connected with Lewis & Kitchen for a number of years as a draftsman and later as an engineer. For over 28 years Mr. Davis was president of the American Warming & Ventilating Co., Elmira, N. Y., retiring in 1945.

ADVANCEMENTS

BAKER, R. A., Br. Mgr., Minneapolis-Honeywell Regulator Co., Syracuse, N.Y. REFERENCES: C. M. Ashley, A. L. Jones, J. W. Stevens, H. G. Strong.

BARR, H. M., Fire Protection Engr. (Trainee) Grinnell Co., Inc., St. Louis, Mo. REFERENCES: E. E. Carlson, T. D. Carr*, H. A. Ray*, R. S. Tait*.

BUNTING, H. L., Owner, Bunting Industrial Sales, Lansing, Mich. REFERENCES: C. H. Pesterfield, R. A. Parsons, K. E. Robinson, L. A. Tilford.

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LEWIS, J. C., Owner, J. C. Lewis Co., Houston, Tex. REFERENCES: H. W. Broadwell, D. S. Cooper, D. M. Mills, R. F. Taylor.

PUGH, H. M., Sales Engr., Thermo-Products, Inc., North Judson, Ind. REFERENCES: Dave Clark*, J. S. Cunningham, W. T. Miller, F. B. Morse.

REICHOW, W. A., Br. Mgr., Minneapolis-Honeywell Regulator Co., Kansas City, Mo. REFERENCES: H. A. Atwater, W. E. Howarth, Henry Nottberg, Jr., C. W. Schumacher.

SPENCER, W. R., Designer, Reeves Instrument Co., New York, N.Y. REFERENCES: Raymond Mirrer*, A. V. Repetto, H. A. Rothburt*, H. T. Updegove*.

Mr. Davis was a member of the Society's Council and he was also on the Finance Committee in 1917.

The Officers and Council of the Society extend their sincere sympathy to the family.

STEWART F. ROBERTSON
Baltimore, Md.

Word has been received that Stewart F. Robertson died of a heart attack on October 23, 1950. Mr. Robertson was born on August 7, 1905 in Baltimore, Md., and attended Baltimore Polytechnic Institute and Johns Hopkins University.

Mr. Robertson was engaged for a year 1924-25 with James Posey as a draftsman and designer of mechanical and electrical installations for buildings. From 1925-28 he was employed with H. Egli now called Egli & Gompf, Inc., as draftsman, designer and supervisor of mechanical and electrical installations for buildings. In 1928 Mr. Roberston joined The Roland Park Co., where he was senior draftsman, designer and principal assistant engineer until 1937. From 1937 until his death, he was with Whitman, Requardt, & Associates, first employed as a mechanical engineer, then made senior mechanical engineer, and in 1946 he was made a partner.

Mr. Robertson was a member of the *ASME* and *ASCE* and was a registered professional engineer in the State of Maryland.

To the members of the family, the Officers and Council of the Society express their sincere sympathy.

ALBERT E. WATTS
Montreal, Que., Canada

Albert E. Watts, chairman of A. E. Watts, Ltd. in Montreal, died on October 11, 1950 at the age of 61. Mr. Watts was born on October 23, 1889 in Liverpool, England, and received his education in England and Richmond, Va.

Mr. Watts was employed successively with the American Locomotive Co., McArthur Bros., and the New York City Department of Water Supply. He moved to Canada in 1911 and became electrical inspector for the Canadian Pacific Railway, Eastern Division. He was mechanical supervisor for the Acme Screw & Machine Co. and later for the Waterville Veneer Co., eventually becoming that company's general manager. Mr. Watts at one time had his own veneer manufacturing plant and refrigeration business. He started in the building heating business in 1930 and was president of A. E. Watts, Ltd. for a number of years until ill health forced him to retire as chairman of his firm.

He was the president of the Canadian Progress Club and a member of the Council Craftsmen of Engineering and the King Edward Lodge No. 78, A.F. & A.M.

He is survived by his wife, to whom the Officers and Council extend their sincere sympathy.

IN MEMORIAM

WILLIS H. CARRIER

1876-1950

THE "CHIEF", as he was affectionately known to his associates and friends, has been called to his eternal reward, and his host of friends in the engineering profession will be saddened by the news of the death of Dr. Willis H. Carrier on October 7, 1950. Dr. Carrier died in Cornell Medical Center of New York Hospital after having spent two weeks there as a patient for a check of a heart ailment. He was chairman-emeritus of Carrier Corp., Syracuse, N. Y., at the time of his death.

He was born on November 26, 1876 in Angola, N. Y., and attended Cornell University, graduating with an M.E. degree in 1901. He received his D.E. from Lehigh University in 1935 and his D.Sc. from Alfred University in 1942.

Dr. Carrier formed the Carrier Engineering Corp., at Newark, N. J., with J. Irvine Lyle and others in 1915, becoming its president. The firm later became the Carrier Corp. He served as president until 1931, when he became chairman of the board.

Dr. Carrier's interest in air conditioning had its origin in the problems of a Brooklyn color processor in 1902, when he was employed as an engineer by the Buffalo Forge Co. As a result of his inquiries into this problem, Dr. Carrier developed in 1903 what was known as a spray-type air washer, and in the course of this work became interested in the general problem of humidification and dehumidification. In 1905 he devised a spray-type air conditioner capable of heating, cooling, humidifying air, the basis for those which are on the market today.

It was as a result of this development that he left the Buffalo Forge Co. where he had become chief engineer in 1906, to pursue the studies that led him to the organization of the Carrier Engineering Corp. in 1915. In 1907 he had patented what was known as *dewpoint control*, a method of regulating humidity by controlling the temperature of the spray-washer in a washer or conditioner of air.

His researches led Dr. Carrier to an exhaustive study of the psychrometric phenomena, including the numerous factors related to the dehumidification of air by the use of mechanical refrigeration. He completed this study in 1911 and presented to the *American Society of Mechanical Engineers* a paper, *Rational Psychrometric Formulae*, which was ranked as fundamental engineering doctrine and upon which was built the science of air conditioning. Thus, Dr. Carrier had earned for himself the title of *father of air conditioning*.

Further studies brought about in 1914 the publication of *Fan Engineering*, which he edited, containing many tables and much data of basic importance. In 1912 he had produced a self-contained air conditioning unit, a combination of motor-driven fan and pump to send air through a spray of controlled temperature, which was probably the first such unit designed for railroad use.

In the ensuing years, Dr. Carrier made numerous contributions to air conditioning. These included the ejector system, first developed in 1916 for the tobacco, food, textile and other industries, and many of the principles used in conditioning the air in theaters and other large public gathering places.

Honorary membership was conferred upon Dr. Carrier in 1944. He was very active in the Society serving as its president, first vice president and second vice president, in 1931, 1930 and 1929, respectively. He was a Presidential member and served on the Advisory Council from 1932-1950. Active in New York Chapter affairs, he served as the Chapter's president and vice president in 1921-22 and 1920-21, respectively. He served on many important committees of the Society among which were:

1917-19	To Cooperate with U.S. Navy Department
1919	To Confer with Weather Bureau
1921-22	Synthetic Air Chart (chairman)
1921-25	Sub-Committee on Ventilation
1923	Membership (chairman)
1923	Sub-Committee on Subjects
1923-25	Executive
1923-28	Sub-Committee on Air Washers and Humidifiers
1924	Membership
1925	Membership (chairman)
1925	Standards of Ventilation (chairman)
1925	To Develop a Ventilation Safety Code under the Procedure of *The American Engineering Standards Committee*
1926-27	Publication
1927-28	Committee on Research
1927-28	TAC to Cooperate with Rochester School Board (vice chairman)
1927-29	TAC on Temperature, Humidity and Air Motion (chairman)
1927-29	TAC on Standards of Ventilation (chairman)
1927-29	Guide Publication
1928	TAC on Garage Ventilation
1928	Meetings Program
1929-30 and '32	Executive
1932	TAC on Re-Study of Comfort Chart and Comfort Line
1933	Nomenclature
1934	Ventilation Standards
1937	TAC on Treatment of Air with Electricity
1938	TAC on Air Cleaning and Atmospheric Impurities (Mechanical Procedures)
1938	Engineering in Its Relation to Public Health
1938	Educational Publicity
1939-44	TAC on Psychrometry
1942 and '45	F. Paul Anderson Award
1945	War Service
1946	Nominating Committee
1947	History Committee

Dr. Carrier was a member of the *ASME*, *ASRE* (president in 1927), *AAAS* (elected Fellow in 1930), Sigma Xi and Tau Beta Pi (Cornell University), *Cornell Society of Engineers* (president in 1939), Technology Club, Engineers Club, Cornell Club, Onondaga Golf & Country Club, and the Century Club.

Dr. Carrier received the following awards: John Scott Medal in January 1932, which was awarded by the City of Philadelphia; the F. Paul Anderson Medal in March 1932, awarded in recognition of outstanding contributions in heating, ventilating and air conditioning by the ASHVE; the *ASME* Medal in 1934; and Franklin Institute's award — the first Frank P. Brown Medal in 1941.

Dr. Carrier served as the United States' representative at the World Engineering Congress in Japan in 1929, and in 1940 was selected as a *modern pioneer of American invention* by the *National Association of Manufacturers*. In 1947 he was one of three Americans invited to address the centenary celebration of *Britain's Institution of Mechanical Engineers*.

Funeral services for Dr. Carrier were held at 11:00 a.m., Tuesday, October 10, at the Park Central Presbyterian Church, Syracuse, N.Y.

Dr. Carrier is survived by his wife, the former Elizabeth Marsh Wise, of 2570 Valley Drive, Nedrow, New York, and two sons, Earl G. (former member of Council) and Vernon G. Carrier.

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● **BALTIMORE:** Organized 1949. Headquarters, Baltimore, Md. Meets, Third Wednesday. PRESIDENT, G. B. Priester, 1101 Lexington Bldg., Baltimore 3. SECRETARY, N. L. Spinelli, 310 N. Gay St., Baltimore 2.

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● **CENTRAL OHIO:** Organized 1944. Headquarters, Columbus, Ohio. Meets, Third Monday. PRESIDENT, H. G. Hays, 851 W. Third Ave., Columbus 8. SECRETARY, A. D. Bogen, 330-34 E. Livingston Ave., Columbus 15.

● **CINCINNATI:** Organized 1932. Headquarters, Cincinnati, Ohio. Meets, First Tuesday. PRESIDENT, E. W. McNamee, 1729 John St., Cincinnati 14. SECRETARY, J. J. Bechtol, R. R. 14, Box 216, Cincinnati 11.

● **CONNECTICUT:** Organized 1940. Headquarters, New Haven, Conn. Meets, Third Thursday. PRESIDENT, D. M. Hummel, 20 Ashmun St., New Haven. SECRETARY, G. F. Nieske, 794 Bee St., Meriden.

● **DELTA:** Organized 1939. Headquarters, New Orleans, La. Meets, Second Tuesday. PRESIDENT, Ralph Elizardi, 3141/2 St. Charles Ave., New Orleans 12. SECRETARY, H. L. Salaun, 317 Baronne St., New Orleans.

● **GOLDEN GATE:** Organized 1937. Headquarters, San Francisco, Calif. Meets, First Thursday. PRESIDENT, Karl F. Baldwin, Jr., 419 Kentucky Ave., Berkeley 7. SECRETARY, Thomas J. Janes, University of California, Berkeley 4.

● **ILLINOIS:** Organized 1906. Headquarters, Chicago, Ill. Meets, Second Monday. PRESIDENT, P. J. Marschall, 14th & Sheridan, North Chicago, Ill. SECRETARY, G. V. Zintel, 1217 W. Washington Blvd., Chicago 7.

● **INDIANA:** Organized 1943. Headquarters, Indianapolis, Ind. Meets, Fourth Friday. PRESIDENT, C. F. A. Locke, 111 E. 34th St., Indianapolis 5. SECRETARY, J. T. Hardin, 3720 N. Pennsylvania St., Apt. 15, Indianapolis.

● **INLAND EMPIRE:** Organized 1950. Headquarters, Spokane, Wash. Meets, First Friday after First Tuesday. PRESIDENT, W. C. Vradenburg, Hutton Bldg., Spokane. SECRETARY, R. J. Harris, 116 N. Division St., Spokane 8.

● **IOWA:** Organized 1940. Headquarters, Des Moines, Ia. Meets, Second Tuesday. PRESIDENT, R. S. Stover, Kresge Bldg., Marshalltown, Ia. SECRETARY, C. H. McGuiness, 712 Park St., Des Moines.

● **KANSAS CITY:** Organized 1917. Headquarters, Kansas City, Mo. Meets, First Monday. PRESIDENT, W. E. Howarth, 101 W. 11th St., Kansas City 6. SECRETARY, W. A. Reichow, 7531 Madison, Kansas City 5.

● **MANITOBA:** Organized 1935. Headquarters, Winnipeg, Man., Canada. Meets, Third Thursday. PRESIDENT, C. M. Fleming, 116 Osborne St., Winnipeg, Man. SECRETARY, W. J. Atkinson, 812 Boyd Bldg., Winnipeg.

● **MASSACHUSETTS:** Organized 1912. Headquarters, Boston, Mass. Meets, Third Tuesday. PRESIDENT, D. W. Blair, 87 Withington Rd., Newtonville 60. SECRETARY, W. A. Williams, 10 Sevinor Rd., Marblehead.

● **MEMPHIS:** Organized 1944. Headquarters, Memphis, Tenn. Meets, Third Monday. PRESIDENT, C. S. Fischer, 367 Adams Ave., Memphis. SECRETARY, A. T. Bevil, 1521 Waverly Ave., Memphis 6.

● **MIAMI VALLEY:** Organized 1950. Headquarters, Dayton, Ohio. PRESIDENT, R. J. Perkins, 621 Third Bldg., Dayton 2. SECRETARY, W. R. Budde, 305 Leo St., Dayton 4.

● **MICHIGAN:** Organized 1916. Headquarters, Detroit, Mich. Meets, First Monday after 10th of month. PRESIDENT, C. F. Donohoe, 2000 Second Ave., Detroit 26. SECRETARY, R. H. Oberschulte, 316 McKerchey Bldg., Detroit 1.

● **MINNESOTA:** Organized 1918. Headquarters, Minneapolis, Minn. Meets, First Monday. PRESIDENT, G. M. Kendrick, 402 Essex Bldg., Minneapolis 2. SECRETARY, J. V. Borry, 6433 Second Ave., Minneapolis 19.

● **MONTREAL:** Organized 1936. Headquarters, Montreal, Que., Canada. Meets, Third Monday. PRESIDENT, R. R. Noyes, Rm. 674, Sun Life Bldg., Montreal. SECRETARY, T. G. Anglin, 540 Prince Albert Ave., Montreal 6.

● **NEBRASKA:** Organized 1940. Headquarters, Omaha, Neb. Meets, Second Tuesday. PRESIDENT, G. W. Colburn, 2865 Ida St., Omaha. SECRETARY, S. W. Black, 18th and Harney Sts., Omaha.

● **NEW YORK:** Organized 1911. Headquarters, New York, N. Y. Meets, Third Monday. PRESIDENT, Carl F. Kayan, Columbia University, Morningside Hgts., New York 27. SECRETARY, Carl H. Flink, Room 3000, 51 Madison Ave., New York 10.

● **NORTH CAROLINA:** Organized 1939. Headquarters, Durham, N. C. Meets, Quarterly. PRESIDENT, M. F. DuChateau, 205 S. Lyndon St., Greensboro. SECRETARY, G. B. Rottman, 401 S. Chapman St., Greensboro.

● **NORTH TEXAS:** Organized 1938. Headquarters, Dallas, Tex. Meets, Third Monday. PRESIDENT, Hyman Blum, 2812 Fairmount, Dallas 4. SECRETARY, R. E. Allison, 607-11 First Ave., Dallas 10.

● **NORTHEASTERN OKLAHOMA:** Organized 1948. Headquarters, Tulsa, Okla. PRESIDENT, A. D. Holmes, 323 W. First St., Tulsa. SECRETARY, J. N. Watt, 528 E. Fifth St., Tulsa.

● **NORTHERN OHIO:** Organized 1916. Headquarters, Cleveland, Ohio. Meets, Second Monday. PRESIDENT, W. M. Rowe, 1502 Swetland Bldg., Cleveland 15. SECRETARY, G. V. Parmelee, 94 Solon Rd., Chagrin Falls.

● **OKLAHOMA:** Organized 1935. Headquarters, Oklahoma City, Okla. Meets, Second Monday. PRESIDENT, R. E. Swan, 2 N. W. Sixth St., Oklahoma City. SECRETARY, W. I. Collins, Jr., 2740 Oklahoma Natural Gas Bldg., Oklahoma City.

● **ONTARIO:** Organized 1922. Headquarters, Toronto, Ont., Canada. Meets, First Monday. PRESIDENT, J. H. Fox, Vanderhoof Ave., Leaside, Toronto 17. SECRETARY, H. R. Roth, 57 Bloor St., W., Toronto, Ont.

● **OREGON:** Organized 1939. Headquarters, Portland, Ore. Meets, Thursday after First Tuesday. PRESIDENT, R. C. Chewning, 402 Failing Bldg., Portland 4. SECRETARY, Dick Blankenship, 725 Cascade Bldg., Portland 4.

● **PACIFIC NORTHWEST:** Organized 1928. Headquarters, Seattle, Wash. Meets, Second Tuesday. PRESIDENT, C. A. Pangborn, 312 2nd and Cherry Bldg., Seattle 4. SECRETARY, W. B. Pride, 3111 Dose Terrace, Seattle 44.

● **PHILADELPHIA:** Organized 1916. Headquarters, Philadelphia, Pa. Meets, Second Thursday. PRESIDENT, J. W. McElgin, 1926 Lycoming Ave., Overlook Hills, Willow Grove. SECRETARY, L. M. Church, 12 S. 12th St., Philadelphia 7.

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● **ROCKY MOUNTAIN:** Organized 1944. Headquarters, Denver, Colo. Meets, First Wednesday. PRESIDENT, R. W. Petersen, 2115 S. Gilpin St., Denver 10. SECRETARY, P. C. Von Rosenberg, 1875 S. Cook St., Denver.

● **ST. LOUIS:** Organized 1918. Headquarters, St. Louis, Mo. Meets, First Tuesday. PRESIDENT, J. S. Rosebrough, 25 Rosemont Ave., Webster Groves 19. SECRETARY, L. L. Hamig, 1706 Olive St., St. Louis 3.

● **SHREVEPORT:** Organized 1948. Headquarters, Shreveport, La. Meets, Third Thursday. PRESIDENT, B. F. Segall, Jr., 603 Cotton St., Shreveport. SECRETARY, R. M. Hood, 411 Louisiana Ave., Shreveport.

● **SOUTH TEXAS:** Organized 1938. Headquarters, Houston, Tex. Meets, Third Friday. PRESIDENT, H. W. Broadwell, 2201 Texas Ave., Houston. SECRETARY, C. L. Fleming, 805-A, M & M Bldg., Houston.

● **SOUTHERN CALIFORNIA:** Organized 1930. Headquarters, Los Angeles, Calif. Meets, Third Wednesday. PRESIDENT, L. J. Helms, 3357 Fairmount Ave., La Crescenta, Calif. SECRETARY, J. S. Earhart, 2734 Fleur Dr., San Marino 9, Calif.

● **SOUTHWEST TEXAS:** Organized 1946. Headquarters, San Antonio, Tex. Meets, Third Tuesday. PRESIDENT, L. S. Pawkett, 816 Insurance Bldg., San Antonio 5. SECRETARY, W. E. Long, Mechanical Engineering Dept., University of Texas, Austin.

● **UTAH:** Organized 1944. Headquarters, Salt Lake City, Utah. Meets, First Wednesday. PRESIDENT, R. H. East, 1086 E. 21st St., Salt Lake City. SECRETARY, D. R. Wilde, 204 Dooly Bldg., Salt Lake City 1.

● **VIRGINIA:** Organized 1946. Headquarters, Norfolk, Va. Meets Third Wednesday. PRESIDENT, W. P. Robinson, 1442 Ocean View Ave., Norfolk 3. SECRETARY, D. E. Phillips, P.O. Box 674, Newport News.

● **WASHINGTON, D. C.:** Organized 1935. Headquarters, Washington, D. C. Meets, Second Wednesday. PRESIDENT, F. M. Thuney, 1919 K St., N. W., Washington 6. SECRETARY, I. M. Bortman, 422 Luray Pl., N. W., Washington 10.

● **WESTERN MICHIGAN:** Organized 1931. Headquarters, Grand Rapids, Mich. Meets, Second Monday. PRESIDENT, K. E. Robinson, 211 Smith Ave., Lansing 10. SECRETARY, F. W. Brundage, 512 N. Park St., Kalamazoo 11.

● **WESTERN NEW YORK:** Organized 1919. Headquarters, Buffalo, N. Y. Meets, Second Monday. PRESIDENT, J. H. Bryce, 120 W. Tupper St., Buffalo. SECRETARY, C. W. Stone, 503 Franklin St., Buffalo 2.

● **WISCONSIN:** Organized 1922. Headquarters, Milwaukee, Wis. Meets, Third Monday. PRESIDENT, F. J. Nunlist, Jr., 2005 W. Oklahoma Ave., Milwaukee 7. SECRETARY, N. E. Hill, 122 N. Hartwell Ave., Waukesha, Wis.

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● **COLLEGE OF CITY OF NEW YORK:** Organized 1949. Headquarters, New York, N. Y. PRESIDENT, Seymour Weinberg, 2147 72nd Street, Brooklyn 4. SECRETARY, Benjamin Karp, 524 Berriman St., Brooklyn 8.

● **LOUISIANA POLYTECHNIC INSTITUTE:** Organized 1949. Headquarters, Ruston, La. PRESIDENT, H. A. Parker, Box 359, Tech Station, Ruston, La. SECRETARY, E. L. Lentz, Box 443, Tech Station, Ruston.

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● **OREGON STATE COLLEGE:** Organized 1949. Headquarters, Corvallis, Ore. Meets, First Wednesday after First Tuesday. PRESIDENT, M. B. Larson, 2311 N. E. Hancock, Portland 12. SECRETARY, Helen P. Lankow, 1349 S. E. Birch St., Portland 14.

● **PURDUE UNIVERSITY:** Organized 1948. Headquarters, W. Lafayette, Ind. CHAIRMAN, John Harrell, 525 S. Chauncey, W. Lafayette, Ind. SECRETARY, Miss June Cox, 403 Maple, W. Lafayette, Ind.

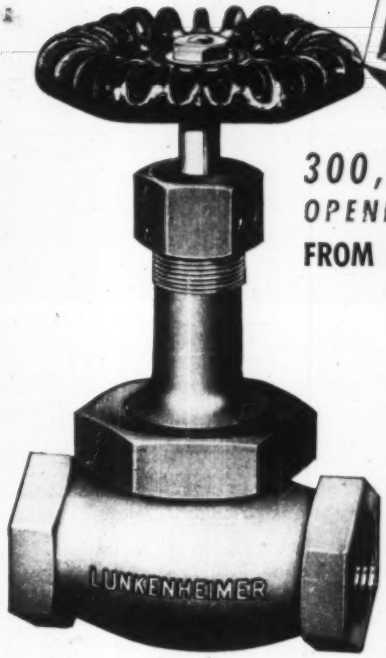
● **TEXAS A. & M. COLLEGE:** Organized 1946. Headquarters, College Station, Tex. Meets, Second and Fourth Tuesday. PRESIDENT, I. O. Kadel, Box 4054, College Station, Tex. SECRETARY, W. C. Haggard, Box 5227, College Station.

● **UNIVERSITY OF DETROIT:** Organized 1949. Headquarters, Detroit, Mich. Meets, First Tuesday. PRESIDENT, L. M. Blanchette, 2245 Holcomb, Detroit 14. SECRETARY, S. H. Kosinski, 4439-30th, Detroit 10.

● **UNIVERSITY OF KANSAS:** Organized 1949. Headquarters, Lawrence, Kans. PRESIDENT, J. L. Williams, 5278 Central, Kansas City, Mo. SECRETARY, R. C. Umholtz, 2752 Michigan St., Topeka, Kans.

● **UNIVERSITY OF TEXAS:** Organized 1949. Headquarters, Austin, Tex. Meets, First and Third Tuesday. PRESIDENT, L. E. Scott, 1221-D Brackenridge Apts., Austin. SECRETARY, E. F. Luker, 1536-A Brackenridge Apts., Austin.

amazing bronze stem gives years of extra service



* Trade Mark Registered

300,000 OPENINGS AND CLOSINGS FROM LUNKENHEIMER'S *Miracle Metal*

Unbelievable? Perhaps, but Lunkenheimer's amazing new bronze stem metal has actually been tested at more than 300,000 openings and closings—the equivalent of years and years of rigorous service. Wear-test machines, carefully controlling torque and number of turns, have registered more than 300,000 cycles in the continuing tests—with live steam flowing through the valves. This stem has also been exhaustively tested under severe field conditions. Literally millions of stems have been placed in service, and not one has ever been returned due to wear failure. The remarkable stem metal, which has revolutionized all prior conceptions of valve stem life, is called Stemalloy*. It is a special-purpose bronze developed exclusively by Lunkenheimer, and is not commercially available. *Only Lunkenheimer valves* have the Stemalloy* stems. Ask your leading industrial distributor for information on the *complete* Lunkenheimer bronze valve line, or write The Lunkenheimer Co., Box 360N, Cincinnati 14, Ohio.

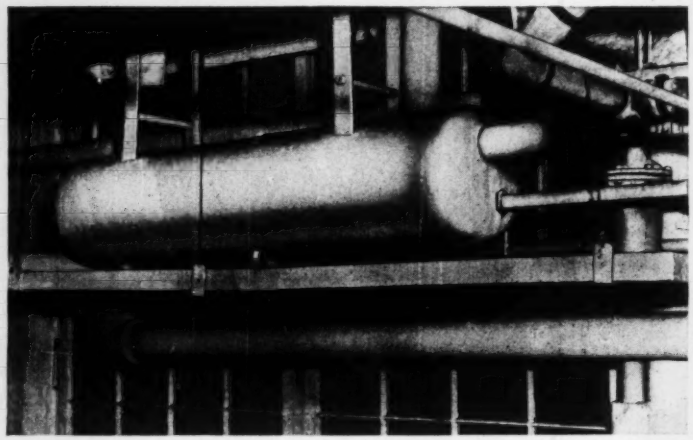
BRONZE • STEEL • IRON

LUNKENHEIMER

THE ONE *Great* NAME IN VALVES

L-1950-9

Water Heater 12 Feet Overhead Supplies 3 Plant Departments



Measuring only a foot in diameter by 4½ feet in length, this single compact No. 625 General Instantaneous Water Heater supplies the quantities of hot water needed in three departments at the Universal Winding Company . . . one of the world's largest textile machinery plants. It operates at 15 lbs. steam pressure . . . well within capacity.

Requires no floor space...no tank... no complicated piping...no long piping runs

The advantages of General Fittings Instantaneous Water Heaters have prompted many companies to add much-needed, extra sources of continuous hot water. These compact, efficient units may be "spotted" almost any place in a plant. Installation is simple and fast. 21 sizes provide a broad range of capacities — up to 300 gallons of hot water a minute. Units are heated with live steam, up to 125 lbs., through the shell . . . or with exhaust steam or boiler water.

If you need an extra source of hot water but are faced with problems such as: space limitations, overall expense, and plant disturbance caused by new construction, look for your ideal answers in a *GENERAL* Instantaneous Water Heater. Send for Catalog 19. General Fittings Co., Dept. A., 123 Georgia Ave., Providence 5, Rhode Island.

GF Instantaneous Water Heater . . . features Bronze Heads—Seamless Copper Tubing.

GENERAL

SEAMLESS AND INSTANT HOT WATER HEATERS AND HEATING SPECIALTIES

Fast Acting Fire Watchman

on duty 24 hours a day...
AT EACH FIRE HAZARD POINT

Let C-O-TWO safeguard your property from fire, even if you have a night watchman on duty. With a C-O-TWO Combination Smoke Detecting and Fire Extinguishing System you have an automatic, round-the-clock fire watchman that simultaneously guards each fire hazard point. The first trace of smoke in a protected area is drawn through pipes to a smoke detector. Immediately an alarm sounds . . . then fast, clean carbon dioxide gas fully floods the stricken area . . . the fire is out before it has a chance to spread and cause extensive damage.

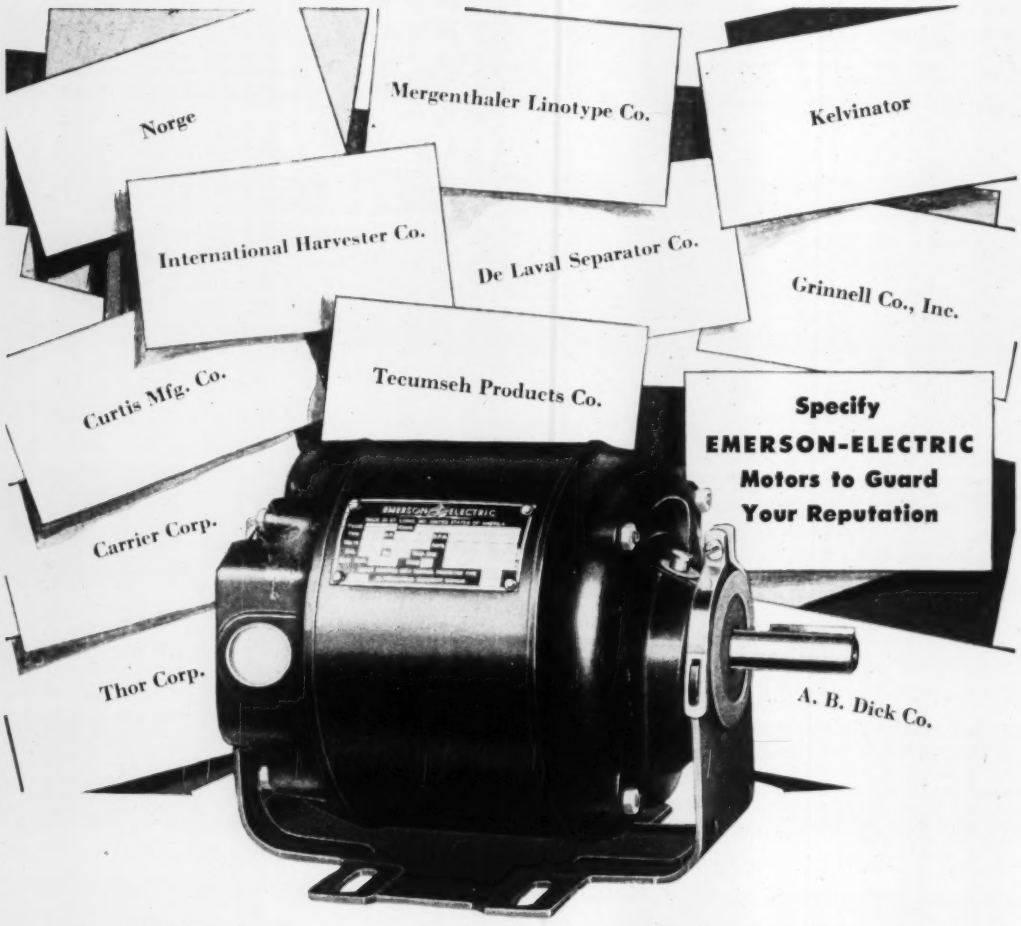
Actual fire tests made by the Underwriters' Laboratories, Inc. show that fire detection with this type of smoke detecting equipment is much quicker than other methods . . . because usually there is smoke or smoldering before flames break out.

There is no water damage, no lingering odors with carbon dioxide . . . only damage is that actually caused by the fire itself. Carbon dioxide is clean, dry, non-conducting and non-damaging . . . harmless to finishes, materials and equipment. The fire is out in seconds, with hardly any interruption or commotion.

Remember fire doesn't wait . . . let an expert C-O-TWO Fire Protection Engineer advise you on your fire protection needs now, before fire strikes. Write today for complete free information!

C-O-TWO

C-O-TWO FIRE EQUIPMENT COMPANY
NEWARK 1 • NEW JERSEY
Sales and Service in the Principal Cities of United States and Canada
AFFILIATED WITH PYRENE MANUFACTURING COMPANY



Called upon...by American Industry

Write for these Emerson-Electric Motor Data Bulletins

Appliance and equipment manufacturers, with applications for motors of 1/20 to 5 h.p., can profitably use these authoritative reference guides. Specifications, construction details and performance data are included for the following types:

- ☐ No. 392-A Capacitor-Start Motors
- ☐ No. 392-B Split-Phase Motors
- ☐ No. 392-C Integral Motors
- ☐ No. 392-D Fan-Duty Motors
- ☐ No. 392-E Oil-Burner Motors
- ☐ No. 392-F Jet Pump Motors
- ☐ No. 392-G Blower Motors

Take a look at these famous names in American industry. They represent but a few of the scores of manufacturers who depend on Emerson-Electric to power their products . . . companies who stake their reputations on the *performance* of Emerson-Electric Motors.

Naturally, we are proud that Emerson-Electric's record of *proved* motor performance has earned the right to be associated with these names.

You may find that adding your name to those above will be the ideal answer to your motor requirements. Emerson-Electric offers you a complete line of motors in the 1/20 to 5 h.p. range . . . motors whose reputation rests on unvarying efficiency and dependability.

We welcome your inquiry. Call on, depend on Emerson-Electric for motors designed to fit your needs.

THE EMERSON ELECTRIC MFG. CO.

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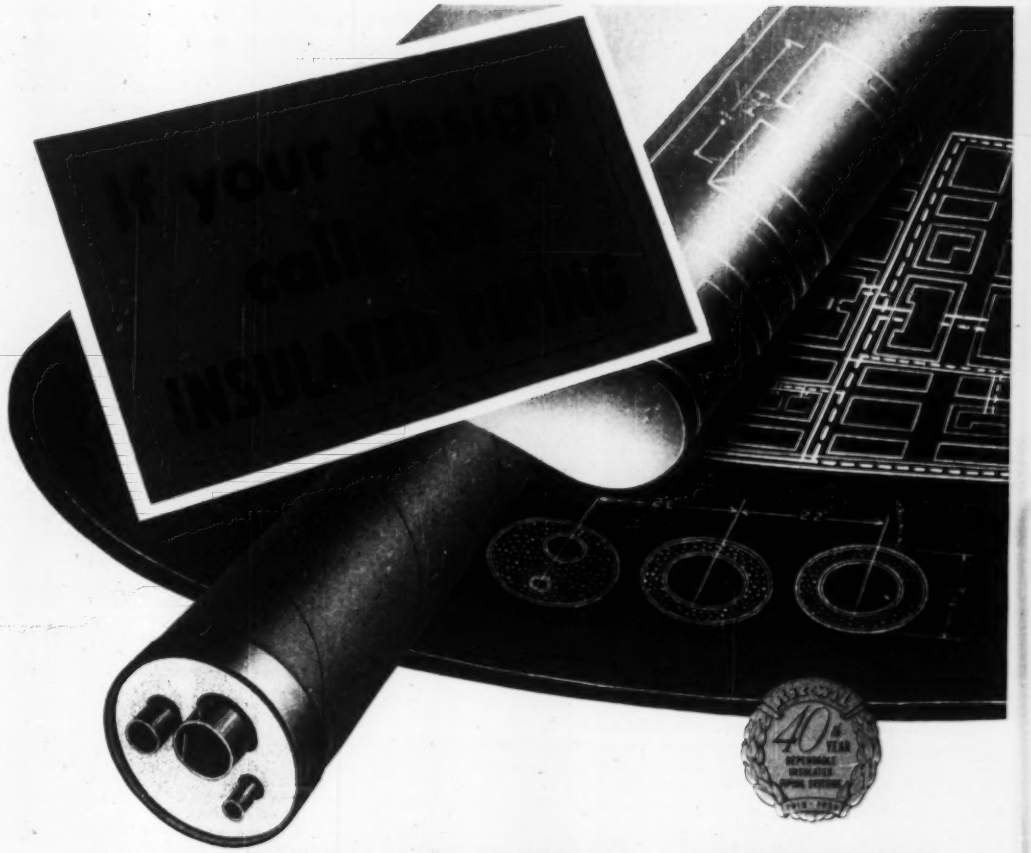
EMERSON ELECTRIC

MOTORS • FANS APPLIANCES



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FOR FORTY YEARS THE GREATEST NAME IN INSULATED PIPING SYSTEMS

For some of the toughest services in industry —

SUPREME SUGAR REFINERY

equips new plant units with

JENKINS VALVES

These Jenkins Valves installed on pipelines serving the pan floor are a few of the 5200 in use at Supreme Sugar Refinery. In addition, several patterns of Jenkins bronze, iron, and steel valves are used to control steam, water, and other vital lines.

There are few tougher proving grounds for valves than sugar mill service. Sticky, sluggish fluids soon seek out any weak spots in design and construction.

Over 5200 valves are maintained in regular service by the Supreme Sugar Refinery of Tallieu, Louisiana. More installations are continually being made as new plant additions go up. Long ago the management learned that, to insure the lasting efficiency required for profitable operation, the *only really safe economy* is to choose the best valves money can buy. For this reason, they standardized on Jenkins Valves.

In fact, Jenkins Valves have been the consistent choice of leading engineers, architects, and contractors everywhere for more and more of the nation's most notable buildings, wherever cost-wise, future-minded planning is the rule. For plant expansion, as well as new plants—large or small; for the commercial and institutional buildings that dominate today's changing skylines, Jenkins Valves are providing an extra measure of dependability, safety, and low maintenance.

Despite this extra value, *you pay no more* for Jenkins Valves. Let the Jenkins Diamond be your guide to lasting valve economy. Jenkins Bros., 100 Park Avenue, New York 17; Jenkins Bros., Ltd., Montreal.

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JENKINS VALVES

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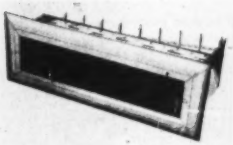
EQUIPMENT DEVELOPMENTS...

For your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the new products and companies listed here to your Directory Section which you received in your January 1950 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in your Directory Section; double asterisk, equipment and manufacturer not listed

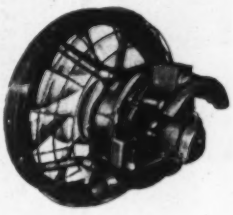
Combination Grille, Air Control Unit

HPAC 1—Duct take-offs can be eliminated with its new combined grille, volume control and deflecting vane, according to Barber-Colman Co., Rockford, Ill.

The air deflecting vanes are used to produce uniform flow across the grille face and minimize turbulence and turning losses. For ease in system balance, the volume control adjuster is accessible from the grille face yet hidden and tamperproof. Supply air deflection can be adjusted vertically and horizontally after installation. Diffusing lugs on the grille fins are used to promote mixing of room and supply air for elimination of drafts and rapid temperature equalization.



Above: Combined Air Grille, Volume Control



Right: Turbine Blower

Turbine Blowers

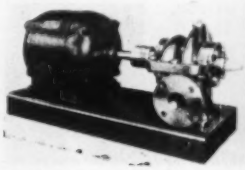
HPAC 2—L. J. Wing Mfg. Co., Linden, N. J., has developed a line of turbine blowers having all-steel turbines and recommended for steam conditions up to 600 psig and 750 F total temperature.

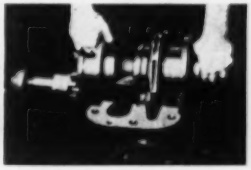
According to the manufacturer, units retain the basic advantages of compactness and lightweight, rugged and dependable design, and low initial and installation cost. These blowers have been modernized with fan impellers of airfoil design and streamlined air entry. The bearings and lubrication system are air cooled.

For oil burner applications, units may be bolted directly to the front windbox without additional supports. They can also be furnished for vertical down discharge or for cementing into boiler brickwork. Capacities range up to 70,000 cfm and units may be used for static pressures up to 20 in. of water.

General Service Pumps

HPAC 3—The new type GS centrifugal pump of De Laval Steam Turbine Co., Trenton 2, N. J., has been designed to fit the idea of a service and exchange plan. All parts except the bare pump casing are contained in the rotor assembly. When maintenance is necessary, the top cover and end plate bolts are removed, the assembly lifted out, and a new one put in place. Through the company's service and exchange plan new rotor assemblies are available for immediate shipment from stock. The old one is





returned and full credit given for all serviceable parts. As an alternate to this, a customer can exchange the entire pump for a factory rebuilt guaranteed pump, with credit allowed for serviceable parts.

Built in three sizes for capacities to 400 gpm, heads to 230 ft, the unit is said to incorporate a number of outstanding design features which include the use of cast iron for the pump case and cover (eliminating the need for integral cast bearing brackets), the use of stainless steel for the shaft (eliminating shaft sleeves), mechanical shaft seals, permanently lubricated ball bearings, a bronze impeller, and end covers designed so that they act as a guide for the liquid pumped to enter the impeller smoothly and also act as a support for the mechanical seal and a housing for the bearings.

[*Continued on page* 158]

FOR YOUR CONVENIENCE **[12-50]**

Heating, Piping & Air Conditioning
6 N. Michigan Ave., Chicago 2, Ill.

Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature

(Circle each HPAC number in which you are interested)

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23							
101	102	103	104	105	106	107	108		110
111	112	113	114	115	116	117	118	119	
121	122	123	124	125	126		128	129	130
131		133	134						

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let your touch feel the difference

Feel the inside of a Gardner-Denver Centrifugal Pump—and you know one of the big reasons why Gardner-Denver Centrifugals rank high in efficiency—why they save pumping costs year after year. Their extremely smooth water passages are correctly proportioned and cast with special care. You feel nothing to impede the smooth flow of water through the pump—nothing to cause power-robbing eddies and backwaters.

For extra pump value, insist on Gardner-Denver quality. For expert assistance on your pumping problems, write Gardner-Denver Company today.

GARDNER-DENVER *SINCE 1859*

Gardner-Denver Company, Quincy, Illinois

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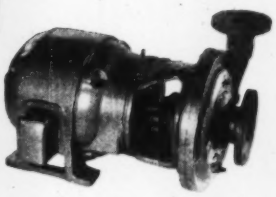
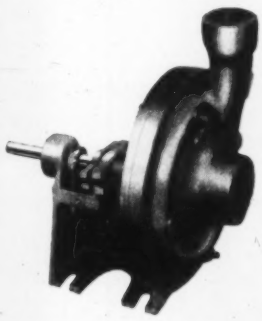
QUALITY PUMPS by GARDNER-DENVER

BIG CAPACITY PUMPS Horizontally split case, double-suction — ruggedly constructed—easy to service—for all heads up to 300 ft.



SPACE SAVING PUMPS Close coupled — for mounting in any position — for capacities to 1200 g.p.m.—heads up to 250 ft.

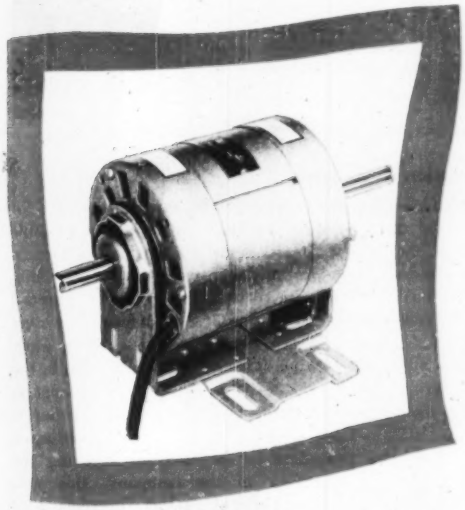
SIDE-SUCTION UTILITY PUMPS Sealed ball bearings are factory lubricated — never need greasing — for capacities up to 3000 g.p.m. and heads up to 100 ft.



RAYTHEON

fractional hp motors

dependable performance



TYPE #470 6-pole, 1050 rpm, 1/15 to 1/8 hp. New economy model featuring drawn steel end bells with self-aligning bearings. Helps you cut production costs—for example you can get the Type #470 at about ½ the cost of comparable capacitor motors, or ⅔ the cost of split phase motors. Typical example of Raytheon "New Principle" design and Creative Electronic Craftsmanship. Write for Bulletin #4000.

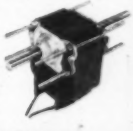
"Count on Raytheon to run it." Design engineers have learned to rely on Raytheon fractional hp motors when they want to *run* things—for example, FANS, BLOWERS and AIR CONDITIONING EQUIPMENT.

Raytheon Creative Craftsmanship assures *Dependable Performance* at the shaft—the kind of trouble-free power unit that manufacturers need in today's competitive markets.

Call in your Raytheon representative for consultation on your specific application.

RAYTHEON Type 230 Shaded 2-pole 1/200 to 1/50 hp at 3200 rpm motor.

RAYTHEON Type 330-S Shaded 4-pole 1/200 to 1/10 hp 1550 rpm motor.



RAYTHEON Type 350 Shaded 2-pole, 1/40 to 1/6 hp at 3000 rpm motor.

RUSSELL ELECTRIC COMPANY

MOTOR DIVISION OF RAYTHEON MANUFACTURING CO.

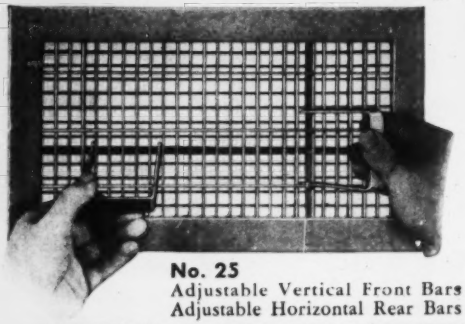
4501 So. Western Boulevard Dept. L-28 Chicago 9, Illinois

INDEPENDENT

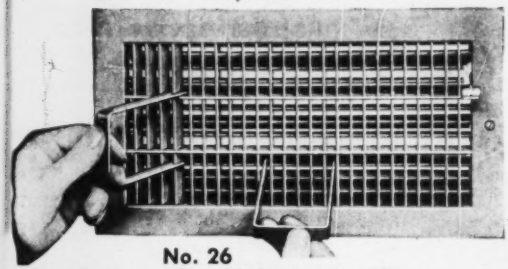
"Fabrikated"

DOUBLE CORE ADJUSTABLE BAR WALL GRILLES AND MULTIPLE VALVE REGISTERS

Each Grille Bar Adjusted Individually



No. 25
Adjustable Vertical Front Bars
Adjustable Horizontal Rear Bars



No. 26
Adjustable Vertical Front Bars
Adjustable Horizontal Rear Bars—with Horizontal Multiple Valves.

Depth with valves closed 1⅜"
Depth with valves open 2¼"

write for new catalog no. 50

MEMBER NATIONAL WARM AIR HEATING AND AIR CONDITIONING ASSOCIATION INDOOR COMFORT

Always Leading • Always Progressing

THE INDEPENDENT REGISTER CO.

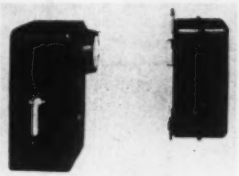
3747 E. 93rd STREET • CLEVELAND, OHIO

[*Continued from page* 155]

Smoke Detector for Duct Systems

HPAC 4—Recommended for use in stores, theaters, hotels, etc., the new photoelectric smoke detector of Photoswitch Inc., 77 Broadway, Cambridge 42, Mass., has been developed for use in air conditioning duct systems.

The type A28E unit detects smoke and through auxiliary relays (not included) may automatically turn off blowers, close automatic shutters, and signal the maintenance department. The unit is supplied with light source type L30R. Features are said to include a sensitive photoelectric circuit with fail-safe circuit design and a tamper-proof sensitivity control to prevent unauthorized adjustments.



Duct Smoke Detector

Fastening Insulation

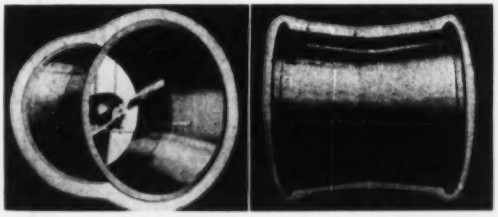
Insulation Fasteners

HPAC 5—Simple, low cost, one man installation of acoustical tile and duct insulation materials is possible through the use of "Quick-Clips", according to Nelson Stud Welding Div., Morton Gregory Corp., Lorain, Ohio.

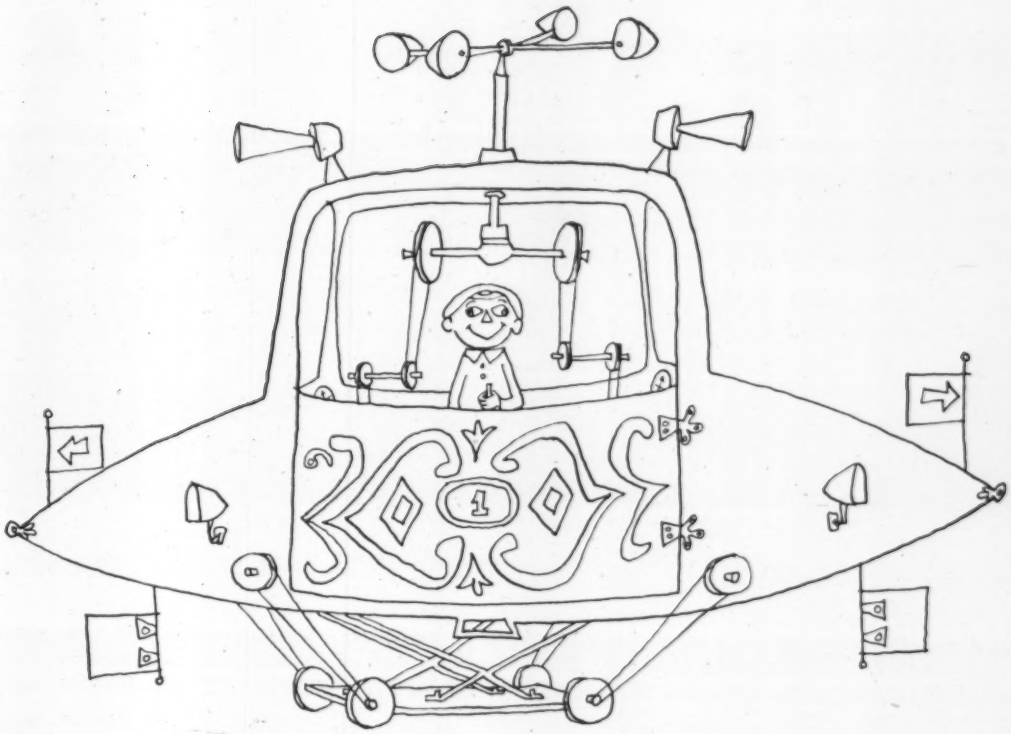
A formed wire clip is used to install insulation material around ductwork and any type of board insulation may be used. The side pieces are cut to fit the duct, while the top and bottom insulation pieces overlap. While the side piece is held in position, one end of the fastener is placed over the edge of the top piece. The fastener is then pulled down and impales the side piece, holding it in place. The procedure is reversed for securing the bottom piece. According to the company, this new method eliminates metal-to-metal contact, prevents heat transfer and condensation, and also minimizes calking work as a tight butt joint is obtained.

Reversible Propeller Fan

HPAC 6—A fully reversible fan is now available from Hartzell Propeller Fan Co., Piqua, Ohio.



According to the company, tests show an air delivery of approximately 20,000 cfm free air by a 36 in. single-propeller fan equipped with a 2 hp motor. The remarkable feature, says the company, is the fact that air delivery is identical when the fan is reversed and air flow is in the opposite direction.



Will it run?

Of course. The inventors are unanimous. Which way? W-e-l-l. *That* they *can't* agree on.

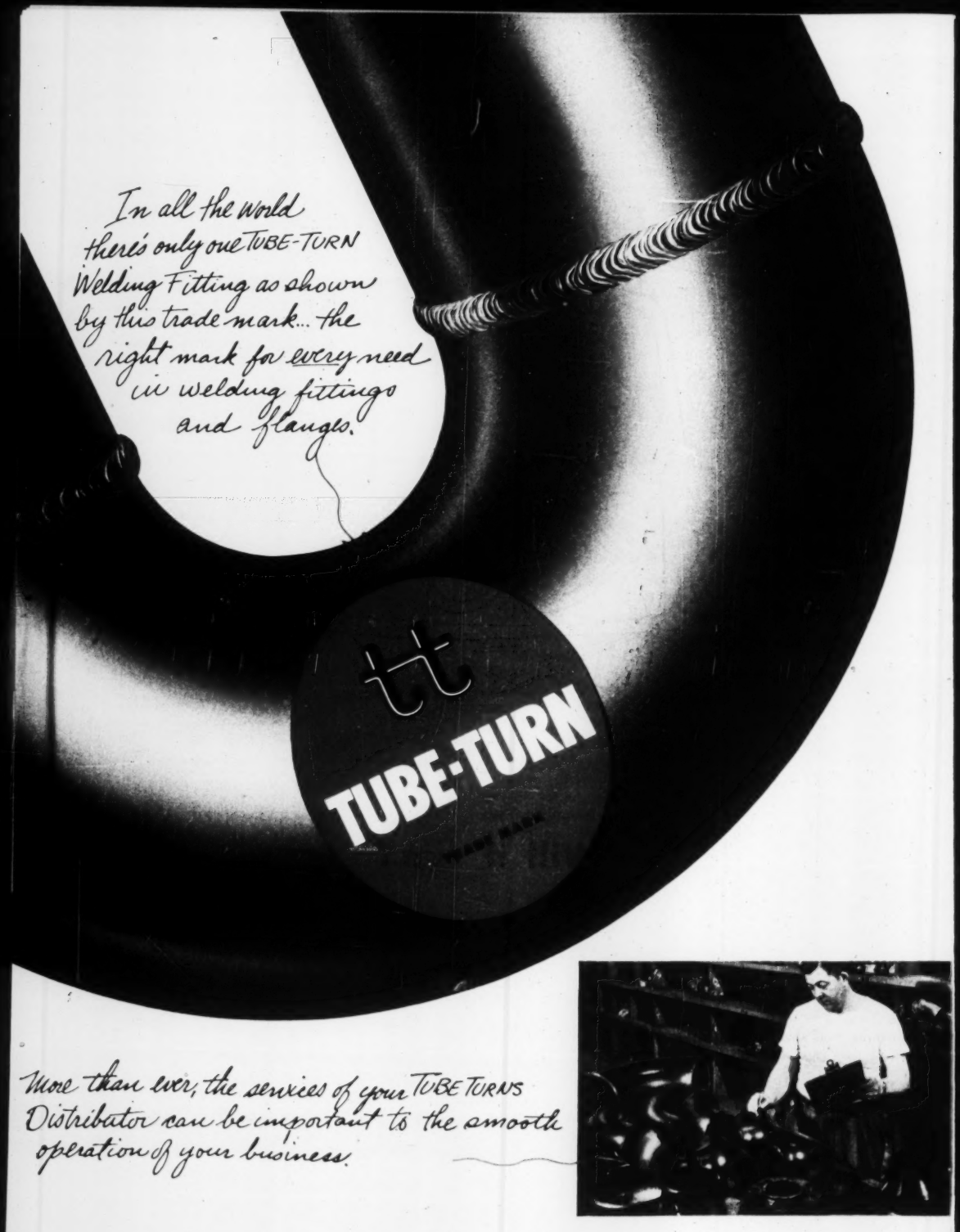
Just the same, this invention has its uses. For instance, it's a perfect example of the dangers of divided responsibility.

It's the sort of thing you avoid when you specify Carrier all the way for air conditioning, refrigeration or industrial heating. Only when the installation is completely Carrier can you be completely sure.

That's our advice. Take it and nobody will ever say about one of your projects . . . "Will it run?"

The best recipe for years of satisfaction is Carrier. Carrier founded air conditioning. Every significant advance in air conditioning from its birth has come from Carrier. These are a few of the many Carrier products all of which will fit your needs best: Conduit and Duct-type Weathermaster Systems for the multi-room building; Evaporative Condensers; Central Air Conditioners; Dehumidifiers; Self-contained Air Conditioners; Reciprocating, Centrifugal and Absorption Refrigeration Machines; Cold Diffusers and Heat Diffusers. Carrier Corporation, Syracuse, New York.

Carrier AIR CONDITIONING · REFRIGERATION · INDUSTRIAL HEATING



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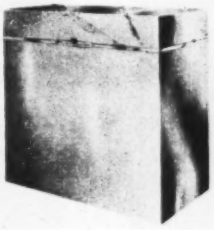
It is recommended for industrial use where air must be circulated in two directions, such as in drying lumber.

Absorption Type Air Conditioner

HPAC 7*—Eureka Williams Corp., Bloomington, Ill. has developed a 10 ton absorption type "Air-O-Matic" air conditioner. Using gas fired, low pressure steam as the source of energy input, the unit is essentially a water chiller which can be used with any air duct system by utilizing suitable coils and filters.

According to the manufacturer, the design permits units to be installed singly or in multiple series in any air conditioning duct system, thus permitting a step by step expansion of air conditioning facilities through additional units and without the necessity of replacing an entire system. Another advantage, stressed by the firm, is the fact that separate units can be installed in various parts of a building, each of which requires a separate temperature.



Air Conditioner

Chlorinizer

High Capacity Chlorinizer

HPAC 8—The new HCVS high capacity chlorinizer of Builders-Providence, Inc., 345 Harris Ave., Providence, R. I., was introduced at the recent annual National Exposition of Power and Mechanical Engineering. It has the visible gas flow feature which is standard on the company's line of equipment and also has automatic control to provide chlorine to three points of application.

The device is said to be a simplified apparatus for metering and controlling chlorine gas feed by manual, semi-automatic, or automatic proportional means. It is recommended for use in the power industry for the control of slimes in cooling water systems, in chemical processing industries, and for the disinfection of water for domestic and industrial water supplies, as well as in industrial waste treatment.

Magnesium Anodes for Corrosion Prevention

HPAC 9**—Extruded, cored magnesium anodes for the protection of large type hot water storage tanks against corrosion are now available from Magnode Products, Inc., 79 Clifton Pl., Brooklyn 5, N. Y.

The anodes are made of a special magnesium alloy, developed by Dow Chemical Co. and are extruded around a steel core. They are available in virtually any length, regardless of tank size, and are shipped with fittings adaptable to various tanks. For the large type industrial and apartment house tanks, the company recommends that anodes extend the entire length of a horizontal tank and that multiple anodes be installed.

These men are working for you

Astute, efficiency-minded J. A. Henby, Vice President in charge of Production, checks on location of new equipment.

Fred Smith, deliberate, analytical Chief Metallurgist, inspects chemical composition test being run on steel tubing.

Keen-eyed, thorough Fred Brown, Chief Inspector, uses micrometer of special design to check hard-to-reach point.

John Ochs, forceful, energetic Superintendent, Fittings Forging Department, smiles over another production record.

GOOD SERVICE right down the line is a tradition at Tube Turns, Inc. And with our production management, good service starts with a quality product—one you can always depend on . . .

That's why an officer of Tube Turns, Inc., is in full charge of production . . . why a noted metallurgist heads up a staff of laboratory technicians who make dead certain that only the finest seamless steel tubing goes into production . . . why a man who helped Tube Turns pioneer welding fittings today supervises the forging process . . . why a veteran inspector and more than 30 trained assistants make no less than 15 visual and instrumental inspections of *each fitting* . . .

These, of course, are the good, sound reasons why you can depend on Tube-Turn welding fittings and Tube Turns' service, always . . . *and all ways!*

"Be Sure You See The Double tt"

TUBE TURNS, INC.

LOUISVILLE 1, KENTUCKY

A Geared Pipe Threader

THAT'S EASY TO WORK WITH

RIDGID No. 4P cuts perfect threads on 2½" to 4" pipe

● No matter how good a threader is, it's a lot better if it's easy to handle. RIDGID 4P has balanced loop handles so you can easily pick it up and put it on pipe—even when it's greasy and you're tired. Mistake proof workholder sets to size *before* you put it on pipe, one screw to tighten, no bushings. 4 sets of 5 high-speed steel chaser dies give clean accurate threads on 2½," 3," 3½" and 4" pipe. Ratchet handle furnished — RIDGID Universal Drive Shaft and Power Drive available for power-threading. For perfect threads, easily, order the RIDGID 4P from your Supply House.

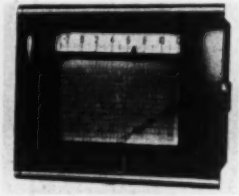
RIDGID
WORK-SAVER PIPE TOOLS

THE RIDGE TOOL CO. • ELYRIA, OHIO

Strip Chart Electronic Instruments

HPAC 10—Bristol Co., Waterbury 20, Conn., has developed a new series 500 strip chart "Dynamaster" electronic instrument. It is a high speed, self balancing a-c bridge designed for measurement of temperature, resistance, conductivity, strain, position, inductance, pressure, force, or any other variable which can be measured in terms of impedance. In addition, the instrument can be used for electric power totalization and as the receiver for the company's "Metameter" system of telemetering.

The measured variable is recorded on a chart 11¼ in. wide. In addition to the single record model, instruments are available for as many as 16 different records on the same chart. Models are offered with a full range of standard chart speeds from 1 in. per hr to 120 in. per min. Supplementing these recording instruments, the company has developed a line of automatic controllers, including both electric operated types and "Free-Vane" pneumatic types.



Above: Refrigerant Liquid Indicator

Left: Strip Chart

Refrigerant Liquid Indicator

HPAC 11—A new straight through liquid indicator with double sight ports is available from Imperial Brass Mfg. Co., 1200 W. Harrison St., Chicago.

When the glass tube is filled with liquid, the indicator on one port is magnified and distorted when viewed from the opposite port, giving definite evidence of sufficient refrigerant. The glass tube is at the surface of the port where it can be easily seen.

The tube is of "Pyrex" glass, with the indicator baked on for permanence. Two seals at each end of the tube are used to protect against leakage. The primary seal is non-resilient and is made of "Teflon," which is impervious to all refrigerants. A secondary resilient seal maintains constant pressure on the glass.

Units are available in 1/4, 3/8 and 1/2 in. sizes with male flare connections on each end and also with a male flare on one end and a female flare on the other.

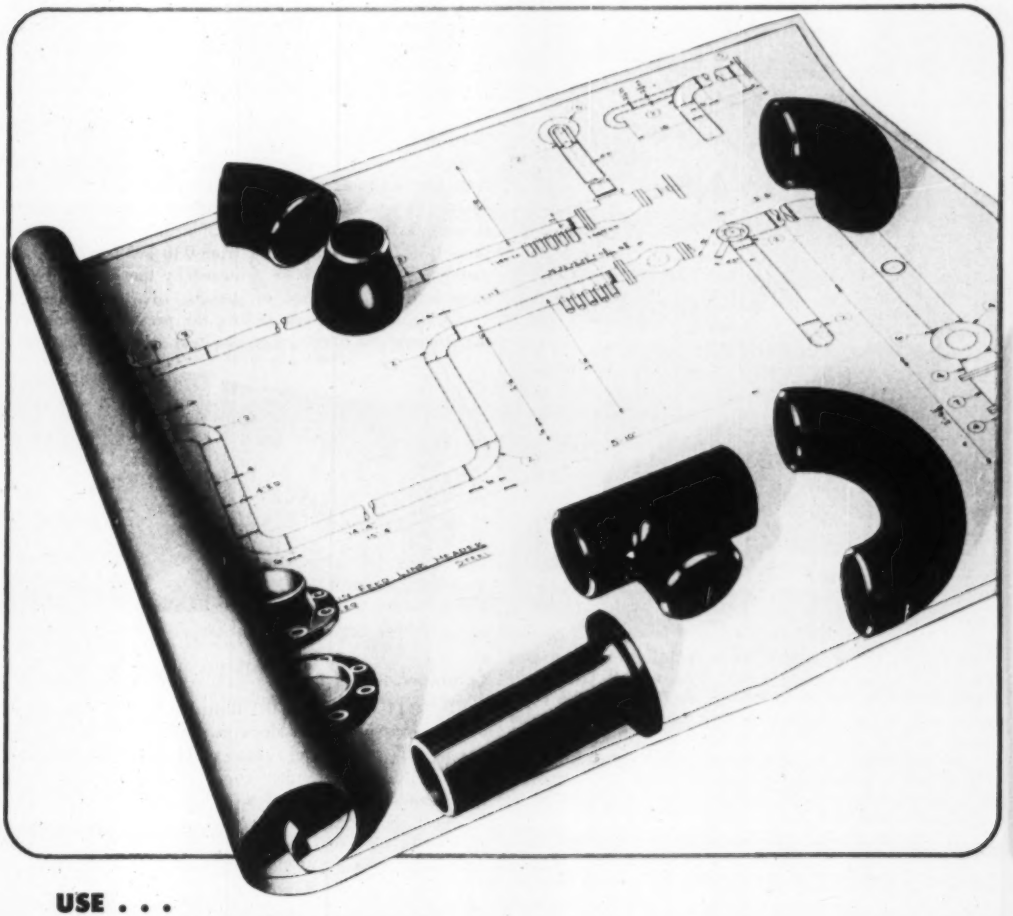
Clock Thermostat

HPAC 12—A universal clock thermostat applicable to all types of heating installations has been developed by Minneapolis-Honeywell Regulator Co., 2604 4th Ave., S., Minneapolis 8.

The new development makes it unnecessary to match heater elements with primary controls, and it can be used for all low voltage gas, oil or stoker control installations. One of the most important advantages of the new thermostat is said to be the simplified installation now possible.

The new "Chronotherm" includes the time modulation principle which was first made available for all types of

TO DO A BETTER PIPING JOB . . .



USE . . .

GLOBE PRECISION PROCESS SEAMLESS WELDING FITTINGS

When you specify and use Globe Welding Fittings you have the product of an organization with unusually broad metallurgical experience. Globe's precision-process method of production reaches back to the manufacture of the Globe seamless tubes themselves which are the "raw material" of Globe welding fitting fabrication.

GLOBE STEEL TUBES CO., Milwaukee 4, Wisconsin

Chicago • Minneapolis • Cleveland • Detroit • New York • Philadelphia
St. Louis • Tulsa • Houston • Denver • San Francisco • Glendale, Cal.

Producers of Globe seamless stainless steel tubes — Gloweld welded stainless steel tubes — carbon — alloy — seamless steel tubes — Globeiron seamless high purity ingot iron tubes — Globe Welding Fittings.

Send for the Globe Welding Fittings Catalog—and look to Globe as a preferred source of supply.

Save water! Save space! Save installation time and money! Save operating costs! Yes, install Governair and *save from $50 to $200 for each ton* of the completely packaged Governair unit designed to fit your needs!

Experience proves Governair can save you up to $5,000 on a 50-ton Governair unit that gives greater dependability and more "engineered efficiency" than ever before!

If you want the best — if you want the most economical and reliable air-conditioning unit on the market . . . CHOOSE GOVERNAIR and SAVE!

AIR CONDITIONERS

EVAPORATIVE CONDENSERS

BLAST COILS FOR HEATING & COOLING

ORIGINATORS OF COMPLETELY PACKAGED AIR CONDITIONERS

GOVERNAIR

UNIT COOLERS

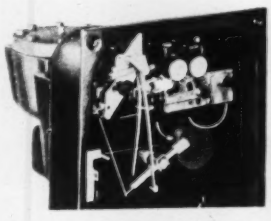
GOVERNAIR CORPORATION • 513 N. BLACKWELDER • OKLA. CITY

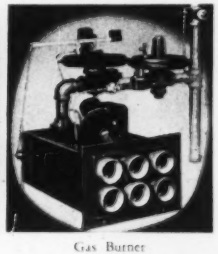
heating installations earlier this year. Basically, the TM thermostats provide for accuracy of control through a new method of supplying a very small amount of artificial heat directly to the bimetal element.

Automatic Flow Controller

HPAC 13—Penn Industrial Instrument Corp., 3116 N. 17th St., Philadelphia 32, has developed a new automatic flow controller designed to provide low maintenance, high accuracy and fast response. Flow rate is measured by the company's "Magna Clutch" flow meter which utilizes a frictionless magnetic coupling between the float and the pen and control mechanism.

High accuracy, says the company, is achieved by the large float and long float travel combined with frictionless design. To this is added the pneumatic controller which is equipped with a fully adjustable automatic reset and proportional band, adjustable from 0 to 175 percent. Low maintenance is said to be achieved by the use of O ring manometer seals in lieu of gaskets. The manometer is accessible without disconnecting the pressure piping and there is only one moving part, the float.


Automatic Flow Controller


Gas Burner

Commercial Gas Burner

HPAC 14—Model 1400 "Multi-Torch" gas conversion burners are specifically designed for conversion of large size heating boilers and furnaces in apartments, churches, office buildings and other commercial establishments to fully automatic gas operation. They are shipped complete in one package and are made in seven capacities from 400,000 to 1,500,000 Btu per hr input. The manufacturer is Bryant Heater Div., Affiliated Gas Equipment, Inc., 17825 St. Clair Ave., Cleveland 10.

The burners are natural draft assemblies designed for ashpit installation and are said to be ideal for gas firing all types of up-draft boilers and furnaces. Assemblies consist of a group of injector torches (3 to 12) attached to a cast manifold and enclosed in a sheet metal duct. A spark ignited "Draft-Lite" pilot, ignition transformer, diaphragm gas control valve, automatic air door and electronic safety cutoff complete the standard equipment. The control components are self-checking during each cycle of operation.

Liquid Sample Cooler

HPAC 15—A liquid sample cooler for cooling boiler and boiler feedwater samples is being produced by Worthington Pump and Machinery Corp., Harrison, N. J.

Suitable for cooling samples required for controlling chemical and refinery processes and for general labora-

Look here

for answers to TOMORROW'S NEW PROBLEMS

NOW that priorities, allocations, cut-backs, and other essential restrictions have returned to the industrial scene, the heating, ventilating, and air-conditioning picture is certain to undergo significant changes in the days to come — to pose new problems for heating, ventilating and air conditioning engineers. That is why attendance at this foremost Exposition of its kind — largest ever staged — takes on greater importance and timeliness than ever. The wealth of first-hand information available here on latest developments, newest trends, available equipment and supplies, and sources of supply, may prove to be an invaluable business asset for the uncertain times ahead.

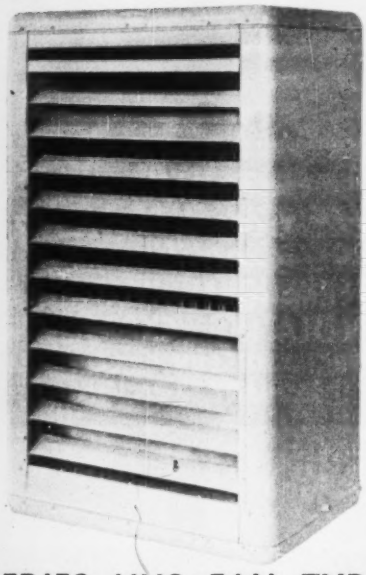
Over 300 exhibitors with their technical representatives will be on hand to show and tell what the future offers for heating, ventilating and air conditioning in all types of commercial and public buildings, industrial plants, and homes. In no other way can so many helpful ideas and valuable contacts be obtained, and so much equipment seen and compared in so little time . . . all so essential to solving tomorrow's new problems.

So plan now to take advantage of this big opportunity. Note the dates.

Auspices of the American Society of Heating & Ventilating Engineers

Management International Exposition Company

JOHN ZINK
-Suspended-
UNIT HEATERS



SERIES UHS FAN TYPE

For clean, safe, trouble-free heating of industrial and commercial establishments, gas-fired suspended heaters have proven themselves and the New John Zink UHS Gas-fired Suspended Heaters assure customer satisfaction. A complete, packaged unit fully automatic, the heaters are suspended from the ceiling to conserve valuable floor space and yet are designed so that they will be an attractive addition to any shop or store.

Heaters for all gases except LPG are equipped with automatic safety shut-off valves that are really automatic. All you have to do is open the pilot light cock and light the pilot. The shut-off starts itself automatically—no buttons to push or hold down. For LPG operation, heaters are equipped with 100% safety shut-off valves.

Standard equipment includes the heater with the fan, motor, fan guard, safety shut-off, regulator (except on LPG), firing cock, line voltage, solenoid valve and thermostat.

AGA APPROVED FOR NATURAL, MIXED, MANUFACTURED OR LP GAS

Write for literature

JOHN ZINK COMPANY

4401 SOUTH PEORIA

TULSA, OKLAHOMA

New York — Salt Lake City — Houston — Los Angeles

tory use, it is of stainless steel construction. It is a shell and tubular coil type heat exchanger of all welded construction designed so that all connections are external to both cooling coil and jackets.

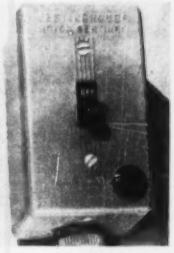
Utilizing the counterflow principle, it is designed for 1500 psi and temperatures of 600 F on the cooling coil side, 150 psi on the stainless jacket side. It has an outside diameter of 3-3/8 in. and an overall length of 11-1/4 in. and is made in capacities of 1/4 and 1/2 gpm.

Manual Motor Starter

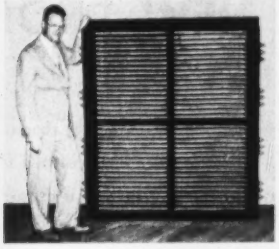
HPAC 16—An improved manual starter, the "Motor Sentinel" class 10-023, specially equipped with an indicating light to show when the motor is running, is available from the Westinghouse Electric Corp., Box 2099, Pittsburgh 30. Used for starting and protecting small a-c and d-c motors used with fans, pumps, compressors, etc., it is available as a double pole switch with ratings up to 1 hp, 250 volts.

Quick-make and quick-break action is provided by an over-center self-indicating toggle mechanism and bimetallic overload protection is also provided. Proper selection of the replaceable heater, says the company, allows sufficient time delay for small motor starting.

The device is housed in an NEMA type 1 enclosure suitable for general purpose application.



Motor Starter



Air Heater

Electric Air Heaters

HPAC 17—The electric heating of large volumes of air for comfort and processing is now possible with its new series of "Chromalox" air blast heaters, according to Edwin L. Wiegand Co., 7610 Thomas Blvd., Pittsburgh 8.

Individual "Finstrip" heaters are assembled in banks to form sections of various sizes which are welded in one large frame for mounting in air ducts. Heaters have monel sheaths and fins to prevent corrosion caused by moisture in the air passing through the ducts.

W. J. Arnold, industrial sales manager, is shown in the photo with one of the heaters which is rated at 440 volts, 192 kw. This particular heater is composed of four separate removable quadrants of 48 kw each with operation flexibility provided by eight distinct circuits for stepped modulation. The complete heater can be wired for infinite control to as low as 10 percent of the full rated capacity.

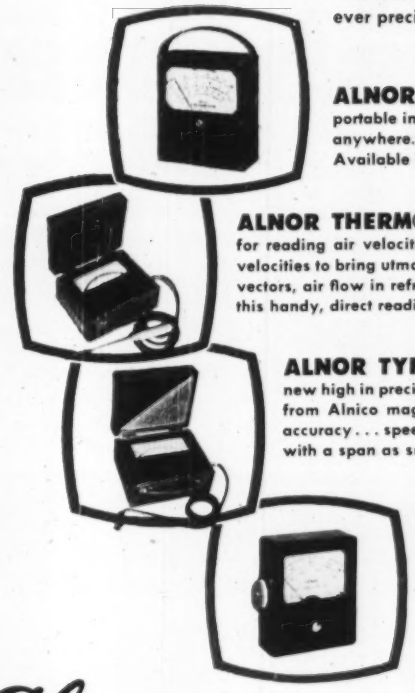
Recording Thermometer

HPAC 18—A continuous record of actual temperatures in refrigerated trucks, railway cars, warehouses, ships, and retail store units is provided by the new "Minicorder",

Alnor OFFERS YOU FOUR WAYS TO Save Time ...Save Money!

Time spent in needless rechecking, balancing and adjusting of heating and air conditioning systems is a waste. It can easily account for much of the cost on every installation and service job.

Here are four Alnor precision instruments that help you do a better job—faster, at lower cost. And like all Alnor instruments —in every industry—the ones shown here are favorites wherever precision and fine craftsmanship are essential.



ALNOR VELOMETER . . . is a precision-built, self-contained, portable instrument that gives instant, accurate readings of air velocities anywhere. Needs no calculations or reference charts . . . is direct reading. Available in wide scale range. Write for Bulletin No. 2448-G.

ALNOR THERMO-ANEMOMETER . . . is a compact, simple instrument for reading air velocities as low as 5 f.p.m. It makes possible fast adjustment of velocities to bring utmost comfort . . . efficiency. Drafts within rooms, flow from convectors, air flow in refrigerated spaces—all these and many more are ideal uses for this handy, direct reading precision instrument. Send for Bulletin 913.

ALNOR TYPE 2300 SURFACE PYROMETER . . . sets a new high in precision measurement of low surface temperatures. Special design from Alnico magnet to finest, quick reacting thermocouple assures unfailing accuracy . . . speed and dependability. Available in 5 Fahrenheit scale ranges with a span as small as 150°. Send for Bulletin.

ALNOR VELOMETER JR. . . . ideal for taking a quick, accurate check on circulation and diffusion of air. Sturdily built, carefully calibrated, the palm-sized Velometer Jr. gives instant reading of air velocities without timing, reference charts, etc. Send for Bulletin No. 725.

Alnor

PRECISION INSTRUMENTS FOR EVERY INDUSTRY

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Illinois Testing Laboratories, Inc.
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Send complete information on the following:

☐ Velometer ☐ Thermo-Anemometer
☐ Type 2300 ☐ Velometer Jr.

Name.....

Address.....

City.....*Zone*.....*State*.....

...with DE BOTHEZAT VERTICAL DISCHARGE ROOF VENTILATORS

Now fumes that are injurious to roofs can be exhausted *straight up* into the air at high velocity with DeBothezat Vertical Discharge Roof Ventilators. Roofs of foundries, machine shops, steel mills, chemical plants and numerous other industrial buildings —as well as adjoining properties— require this extra protection.

DeBothezat Vertical Discharge Roof Ventilator is a motor-driven fan in a weatherproof housing. Unit provides controlled ventilation at all times, regardless of outside wind or weather. Available with fan wheels 36", 42", and 48" in diameter, with capacities up to 40,900 cubic feet of air per minute.

Keeping the air in your plant pure and free from harmful dust and fumes is as important in winter as in summer. DeBothezat Vertical Discharge Roof Ventilators satisfy this need. SEND FOR FREE BULLETIN.

Address Dept. H1250

DeBOTHEZAT FANS DIVISION
American Machine and Metals, Inc.
EAST MOLINE, ILLINOIS

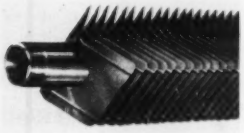
a self contained recording thermometer developed by Tagliabue Instruments Div., Weston Electrical Instrument Corp., Box 414, 614 Frelinghuysen Ave., Newark 5, N. J.

The unit does not require connection to a power supply, and is designed to record temperatures over a period up to seven days without attention. The device is said to be shockproof and is a completely self contained recording thermometer with a temperature range, in various models, within the limits of —30 F to 165 F. Charts are available for 24-hr, 72-hr, 3-day, and 7-day recording. Special two-pen models are made for on-off recording of related equipment.

Finned Radiation

HPAC 19**—Designed to give a large amount of radiation surface, the new slanted fin pipe of Slant-Fin Radiator Corp., 5113-17 Second Ave., Brooklyn 32, N.Y., is offered in 1¼ and 2 in. pipe sizes.

The fin is said to provide unusual heat transfer because of the patented tempered steel flange which grips the pipe, at the same time expanding and contracting as the pipe expands and contracts. The flange on each fin interlocks with the preceding fin to insure alignment and spacing. The neat, solid panel effect, says the company, gives the heating element a finished appearance which makes it suitable for use without a cover on ordinary industrial applications. For hospitals, offices, etc., a line of enclosures is available.



Above: Finned Radiation

Right: Convection Heater

Overhead Convection Heater

HPAC 20—A new type of overhead forced convection heater was introduced at the recent American Gas Association convention in Atlantic City by Norman Products Co., 1150 Chesapeake Ave., Columbus 12, Ohio.

Distributing heat in a 360 deg radius, the No. 360 heater is said to contain engineering features of outstanding practicality. The shallow depth and on-the-ceiling installation of the heater are said to provide ample head room and the forced exhaust of combustion products is designed to eliminate venting problems and air contamination.

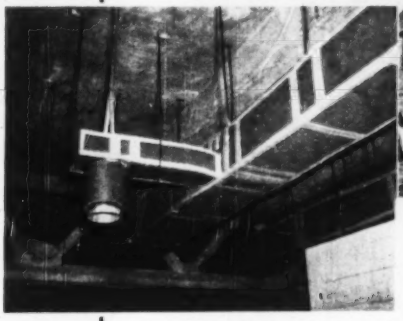
A low velocity impeller distributes warm air through seven diffuser rings across the ceiling in a 360 deg radius. This air is said to travel down all four walls, blanketing the entire floor area on its way back to the return air intake in the bottom of the unit. This characteristic aspiration and diffusion effect, says the company, results in a chain reaction of turbulent air motion set up with the entire radius of diffusion of the heater so that temperature is equalized throughout the room and a continuous air motion in the occupancy zone within low acceptable velocity limits is established.

The unit is rated at 100,000 Btu and other sizes will be available soon.

Grant Wilson DUX-SULATION

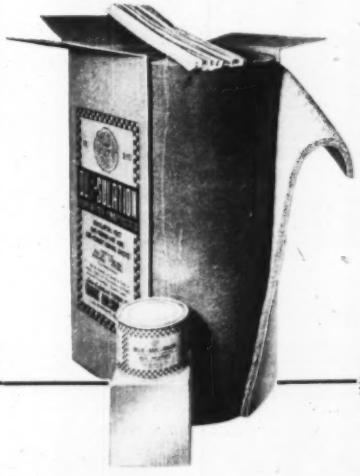
contributes to the comfort of the traveling public and to the overall efficiency of the new . . .

Port Authority Bus Terminal



Artist's sketch of Terminal designed to accommodate 2,500 intercity buses.

Photo of duct section in new Terminal insulated with Grant Wilson Dux-Sulation.



★ DATA: Grant Wilson Asbestos-Protected DUX-SULATION is a Thermal/Acoustical insulation engineered specifically for duct application. K factor is .27 BTU and sound absorption is approximately 61%. Installation is fast and simple, and insulating values are constant. Width is 36" in rolls about 33 feet long, 1" or ½" thickness, with special tape and glue furnished.

Inspect Dux-Sulation yourself. Send for this Sample Kit 12535-H. Write Grant Wilson Inc., Board of Trade Bldg., Chicago 4, Ill.

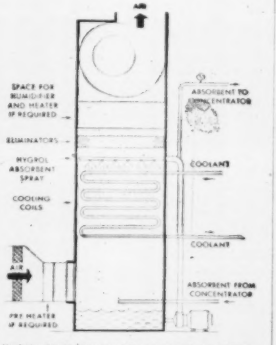
Grant Wilson inc.

ASBESTOS and INSULATING MATERIALS

How You Save with the NEW Niagara Method of Air Conditioning

Using "Hygrol" Absorbent Liquid

Because it absorbs moisture from the air directly, the new Niagara Controlled Humidity Method uses less, or no, mechanical refrigeration for dehumidifying. You save first costs and installing of heavy machinery. You save space, maintenance expense, power. Easier, convenient operation.

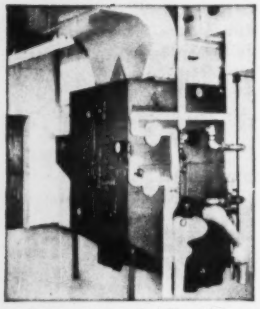


NIAGARA CONTROLLED HUMIDITY METHOD — FLOW DIAGRAM

Using "Hygrol" hygienic absorbent liquid, this method gives complete control of temperature and relative humidity. Especially, it is a better way to obtain dry air for drying processes, packaging hygroscopic materials, preventing moisture damage to metals, and obtaining better quality for chemical process products and food products—or in obtaining better results in comfort air conditioning for office or laboratory at lower refrigeration costs.

The diagram shows how filtered air is dehumidified by passing thru a spray of "Hygrol"— a liquid absorbent which removes air-borne moisture. This liquid is hygienic and non-corrosive; it contains no salts or solids to precipitate and cause maintenance troubles. It is continuously reconcentrated at the same rate at which it absorbs moisture, providing always the full capacity of the air conditioner, automatically.

Food Packaging under Controlled Humidity


Niagara Controlled Humidity Air Conditioner

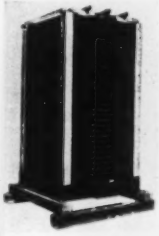
Units provide a range of capacities from 1000 to 20,000 C. F. M. Multiple unit installations are in use successfully. Records of results are available.

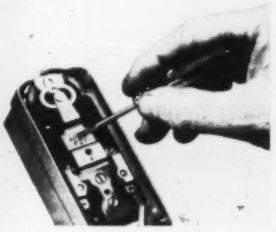
For further information, write to Niagara Blower Company, Dept. HP, 405 Lexington Ave., New York 17, N. Y.

Small Capacity Cooling Tower

HPAC 21—The new type H atmospheric spray cooling tower of Binks Mfg. Co., 3114-40 Carroll Ave., Chicago 12, is designed for use with small packaged water cooled air conditioning and refrigeration condensing units and related applications.

The unit is offered in 10 frame sizes for refrigeration loads ranging from 3 to 35 tons. The pan is made with external bolting flanges for convenient and firm anchoring of the tower and to eliminate piercing the floor of the water basin. Other features include the use of newly designed corner posts (designed to bolt easily and rigidly to the pan sides), slip-fit louvers (said to slide in place through machine slotted corner posts), and a float box which is an integral part of the basin but is mounted externally for easy access to the control valve. Spray nozzles used are the company's "Rotojets", which are said to be clogproof and which operate on a patented off-center inlet, whirl chamber principle.


Cooling Tower


Adjustable Thermostat Heater

Adjustable Thermostat Heater

HPAC 22—Perfex Corp., 500 W. Oklahoma Ave., Milwaukee 7, is now manufacturing thermostats with built-in adjustable heaters which are designed to eliminate the nuisance of carrying a variety of heater coils or plugs in order to have the proper heater in the thermostat.

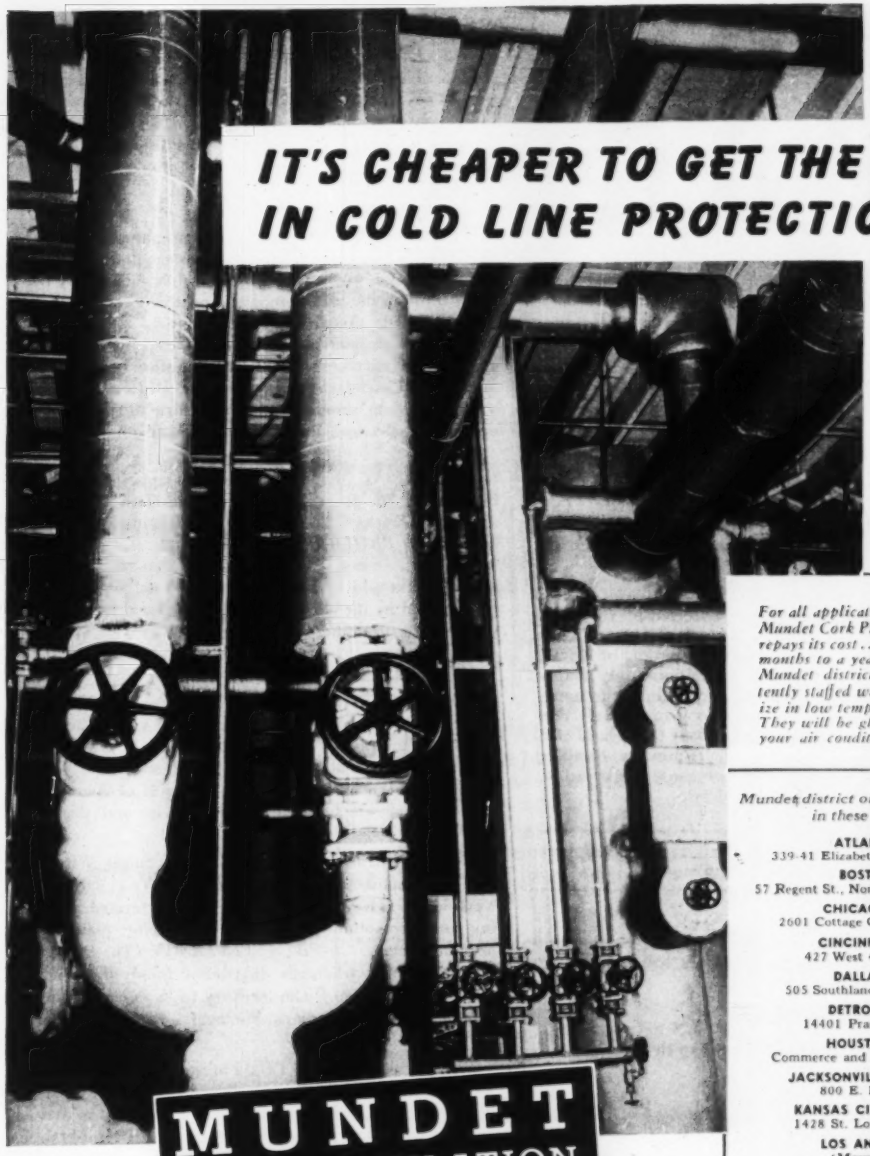
Adjustments ranging from 0.4 to 0.8 amp, are said to cover almost every installation and to be quickly and simply made by turning an adjusting screw on the back of the thermostat. After the adjustment is made, the "Magic Dial" takes over to provide the desired temperature.

Thermal Insulation

HPAC 23**—Reflectal Corp., 155 E. 44th St., New York 17, is marketing a new low cost insulation and vapor barrier material called "Dryfol".

It is a building product combining a kraft paper with pure aluminum foil on one or both sides. According to the manufacturer, when combined with an air space it reflects 95 percent of all radiant heat striking its metallic surface. The type B material is said to be equal to 1½ in. of mass type insulation in ceilings and side walls during summer conditions. During the winter, it is said to be equal to 1½ in. of mass type insulation in underfloor space and side walls, and 1 in. in ceilings. The permeability is said to be better than 0.08.

Each roll of the insulating material contains 250 sq ft and is available for use in 17 in., 25 in., 33 in., and 36 in. widths. The manufacturer recommends a minimum of ¾ in. air space adjacent to each reflective side of the insulation.



IT'S CHEAPER TO GET THE BEST IN COLD LINE PROTECTION . . .

For all applications of refrigeration, Mundet Cork Pipe Covering quickly repays its cost . . . frequently within 8 months to a year of the installation. Mundet district offices are competently staffed with men who specialize in low temperature applications. They will be glad to help you solve your air conditioning problems.

Mundet district offices are located in these cities:

ATLANTA
339-41 Elizabeth Street, N.E.

BOSTON
57 Regent St., North Cambridge 40

CHICAGO 16
2601 Cottage Grove Avenue

CINCINNATI 2
427 West 4th Street

DALLAS 1
505 Southland Life Annex

DETROIT 21
14401 Prairie Street

HOUSTON 1
Commerce and Palmer Streets

JACKSONVILLE 6, FLA.
800 E. Bay St.

KANSAS CITY 7, MO.
1428 St. Louis Avenue

LOS ANGELES
(Maywood)
6116 Walker Avenue

NEW ORLEANS 16
315-25 N. Front Street

NEW YORK 17
331 Madison Avenue

PHILADELPHIA 39
856 N. 48th Street

ST. LOUIS 9
3176 Brannon Avenue

SAN FRANCISCO 7
440 Brannan Street

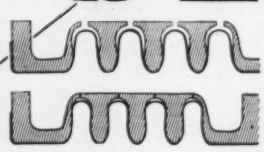
In Canada:
Mundet Cork & Insulation, Ltd.
35 Booth Avenue, Toronto

MUNDET CORK INSULATION

Mundet Cork Pipe Covering provides the essentials of most effective insulation: low thermal conductivity; non-absorbence; sanitation and permanence. Write for specification information, heat loss charts and other helpful data. Inquiries receive prompt attention. Mundet Cork Corporation, Insulation Division, 7101 Tonnelle Ave., North Bergen, N. J.

CORK PIPE COVERING · CORKBOARD

D-F S-E*



*EXPANSION JOINTS

The importance of D-F S-E to you may be measured in dollars. Maintenance costs are reduced to a minimum. Initial cost is amortized over a long life. Case histories show BADGER D-F S-E EXPANSION JOINTS installed in the early thirties are still on the job.

D-F S-E could mean definite financial savings effected —actually D-F S-E does mean *Directed-Flexing Self-Equalizing. Directed-Flexing, an exclusive construction feature in Badger Joints, is a combination of an all-curve corrugated member and correspondingly shaped Self-Equalizing rings which not only limits the movement of each corrugation but also progressively controls each increment of movement over the area of each corrugation. This construction eliminates localized stresses which cause metal fatigue and break-downs.

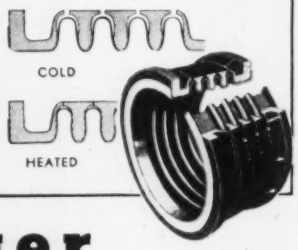
Send for your copy of Badger's new twenty-four page catalog today.

All-curve flexing guarantees longer life

Badger Joints flex like this . . .

not like this . . .

. . . this stress-free flexing principle exclusive with Badger



Badger
MANUFACTURING COMPANY
230-260 BENT STREET CAMBRIDGE 41, MASS.

We Hear That . . .

POWERS REGULATOR CO., Chicago, is erecting a new general office and factory building. Scheduled for completion next summer, at the time of the company's 60th anniversary, the new plant is located on the firm's 13 acre site in Skokie, Ill. The two story office, test and research laboratory section will be completely air conditioned.

The fall series of educational control shows, offered by *PENN ELECTRIC SWITCH CO.*, Goshen, Ind., which began in Chicago last September and which is currently travelling through the midwestern and north central states, has been extended. According to the company, there has been considerable demand for additional shows in the midwest area, and the meeting schedule has therefore been extended to include Pittsburgh, Columbus and Dayton. Meetings are designed to provide technical information on control operation, selection, installation, and adjustment.

SERVEL, INC., Evansville, Ind., has appointed two new distributors for its all-year air conditioners. The firms are *BEHLER-YOUNG CO.*, Grand Rapids, Mich., and *DEMMLER BROTHERS CO.*, Pittsburgh. . . . *BRUNNER MFG. CO.*, Utica, N. Y., has let contracts for its seventh plant which will be constructed on property presently owned by the company. The additional facilities will enable the firm to increase production at least 25 to 35 percent.

ROSS INDUSTRIES CORP., parent company for *J. O. ROSS ENGINEERING CORP.*, New York City, has awarded a contract for a plant expansion to H. K. Ferguson Co., industrial engineers and builders. The project will provide an extension of 75,000 sq ft of floor space, part of which will be used for laboratories and offices.

BAKER REFRIGERATION CORP., South Windham, Me., has appointed *GOOLD AND TIERNEY, INC.*, New York, as its advertising agency. An accelerated advertising and promotion program is now being planned for next year ..... *B. A. PETERSON CO.*, Dowagiac, Mich., is a new wholesale distributor for *F. W. DWYER MFG. CO.*, Chicago. The territory to be covered includes Wisconsin, Illinois, Indiana, Michigan and the Twin Cities.

BROWN PRODUCTS CO., Forest Hills, N. Y., has installed a warm wall type baseboard testing booth at the Walter Hervey Junior College, New York City, in accordance with the Institute of Boiler and Radiator Manufacturers' testing and rating code for baseboard type radiation. Tests can be performed on both flush and recessed baseboards with either steam or hot water and, with minor alterations, the booth can be converted to test free standing or recessed convectors. The booth will be made available for student use.

The 25th anniversary of the *AMERICAN GAS ASSOCIATION* laboratories was a feature of the recent AGA annual convention. A special booth in the Atlantic City Auditorium was one of the tributes to the quarter century of progress of this testing organization.

Ready!

A NEW DUAL DUCT AIR CONDITIONING SYSTEM

FOR

MULTISTORIED BUILDINGS

EMBODIES THE ADVANTAGES OF ALL CURRENT PRACTICE WITH HIGH PERFORMANCE AND LOW TOTAL OWNING AND OPERATING COST. EXISTING STRUCTURES ARE SERVED AS WELL AS NEW BUILDINGS.

MAJOR FEATURES

PRACTICAL

SIMPLE

NO CONCEALED WATER PIPES
NO CONCEALED DRAINS TO CLOG
NATURALLY NO POSSIBILITY OF CORROSION
NO WATER OR STEAM COILS IN DISTRIBUTING UNITS TO CATCH DUST; THEREFORE NO AIR CLEANING DEVICES REQUIRED IN THE UNITS
NO POSSIBILITY OF CONDENSATION AT THE DISTRIBUTING UNITS
NO FANS AND CONSEQUENTLY NO ELECTRIC CONNECTIONS ARE REQUIRED AT THE DISTRIBUTING UNITS

FLEXIBLE

ALL THE CONDITIONING AND CLEANSING OF THE AIR IS ACCOMPLISHED AT CENTRALLY LOCATED STATIONS WHERE IDEAL MAINTENANCE CAN BE HAD

REASONABLE COST

EACH AND EVERY CUBICLE CONDITIONED HAS ITS INDIVIDUAL TEMPERATURE CONTROL PERMITTING THE HEATING OF ONE CUBICLE WHILE COOLING THE NEXT ONE

PARTITION ALTERATIONS AS MAY BE NECESSARY FOR TENANT CONVENIENCE REQUIRE NO CHANGE OF THE AIR CONDITIONING DISTRIBUTION. ALL THIS WITH SMOOTH PERFORMANCE AT THE LOWEST TOTAL OWNING AND OPERATING COST.

SYSTEM PROTECTED BY PATENT APPLICATIONS

THE **BUENSOD-STACEY** DUAL DUCT SYSTEM HAS BEEN THOROUGHLY OWNER-TESTED ON MANY PROJECTS. NAMES ON REQUEST.

BUENSOD-STACEY

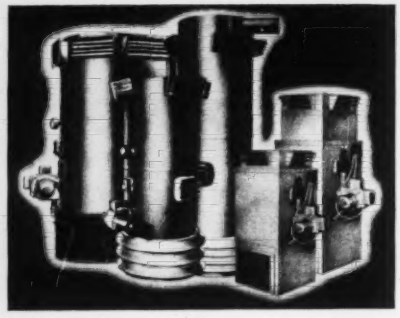
INCORPORATED

NEW YORK GREENSBORO CHARLOTTE

Now . . . A COMPLETE LINE *of*
INDUSTRIAL SELF-CONTAINED UNIT HEATERS
For Any Application

THERMOPAC
(OUTPUT 100,000 and 200,000 btu's/hr.)
HORIZONTAL SUSPENSION OR FLOOR SET

THERMOBLOC
(OUTPUT 300,000, 550,000 and 1,000,000 btu's/hr.)

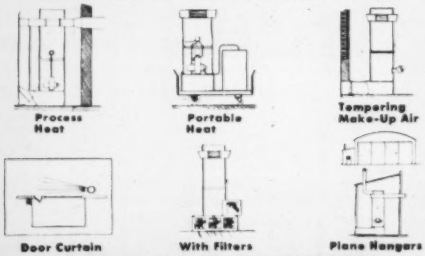


The fundamental principles of high heat transfer, simplicity and completely automatic operation have been incorporated in three new units, augmenting the two basic THERMOBLOCS that have been so well accepted. These five units offer a complete range of 100,000, 200,000, 300,000, 550,000 and 1,000,000 btu's hr., filling every application from the smallest to the largest plant requiring multiple installations. And, THERMOBLOCS are completely automatic in operation, need no attendant.

THERMOBLOC is the ideal heater for buildings with large, unobstructed areas: freight terminals, machine shops, assembly lines and the like. Silent THERMOBLOCS are used in super markets, dance halls, auditoriums. Standard units are adaptable to many unusual heating applications, as shown below. Better get the whole story on THERMOBLOC, the most useable direct-fired heater on the market.

Write for the new data book containing tables and engineering data on heating constants, building materials, etc. It will aid you in determining the heating requirements of your plant. To solve your heating problems, call our engineers and let them show you the many advantages of THERMOBLOC.

STANDARD THERMOBLOCS ARE ADAPTABLE
TO A WIDE RANGE OF HEATING JOBS



THERMOBLOC DIVISION
PRAT-DANIEL CORPORATION
Manufacturers of P-D Power Equipment
70-12 Water Street East Port Chester, Conn.

DRAYER-HANSON, INC., Los Angeles, has completed its reorganization plan and new common stock is being issued in lieu of the outstanding class A and common shares. *GEORGE J. MORTON*, a former Indiana industrialist who recently acquired an interest in the firm, is president. Other officers include *ALBERT HANSON*, vice president and secretary, and *C. T. LISKE*, treasurer and controller.

Greatly increased demand for products of *BELL & GOSSETT CO.*, Morton Grove, Ill., has outweighed rising production costs to permit the firm to pay a special bonus of approximately $100,000 to all its office and factory employees. The company has also declared a regular quarterly dividend of 30 cents a share on common stock, placing it on a $1.20 annual basis, and an extra dividend of 25 cents a share. . . . . Employment at *MINNEAPOLIS-HONEYWELL REGULATOR CO.*, Minneapolis, has reached 15,700 persons. This figure is a new high for the company as the previous peak, which was reached during the last war, was 14,000 employees.

JACK M. LEVY, of Levy & O'Keefe, consulting engineers, *PETER B. GORDON*, of Wolff and Munier, Inc., and *EDWARD J. BENESH*, of Syska & Hennessy, consulting engineers, are among the lecturers for the second annual seminar on new developments in heating and air conditioning, now under way at *NEW YORK UNIVERSITY*. The fifteen lecture-discussion sessions, open only to professional engineers and those working in the field, began last September and will terminate in January.

BINKS MFG. CO., Chicago, has purchased a new plant at 4915 Pacific Blvd., Los Angeles. The plant, designed for light industrial work and formerly occupied by Allegheny Ludlum Steel Corp., is under the direction of *J. E. ROCHE*, manager of the west coast division, and is the focal point for all branch office work involving warehousing and sales.

New Power for America is the title of a new 16 mm colored sound motion picture produced by *COMBUSTION ENGINEERING-SUPERHEATER, INC.*, New York City. The film tells the story of power in the postwar period, first depicting the ever-increasing use of electrical energy, then tracing the progress made in science of power generation during the last three decades, and finally portraying the vast postwar expansion program of the utility industry. Engineering schools, societies and other organizations interested in scheduling this film should address their inquiries to the company at 200 Madison Ave., New York 16. Running time is approximately 35 min.

FRIGIDAIRE DIV., GENERAL MOTORS CORP., Dayton, Ohio, recently conducted a series of five regional field meetings for the purpose of discussing present and future commercial refrigeration and air conditioning sales programs. Sales representatives from 11 districts throughout the country attended two-day sessions in Atlanta, New York, Chicago, Kansas City, and San Francisco.

In a move to further diversify its manufacturing operations, *H. K. PORTER CO., INC.*, Pittsburgh, has acquired *CONNORS STEEL CO., INC.*, Birmingham, Ala., producer

of electric furnace steel and steel products. ..... *PHILIP CAREY MFG. CO.*, Cincinnati, and *ASBESTONE CORP.*, New Orleans, are handling the stud welding fasteners of *NELSON STUD WELDING DIV., MORTON GREGORY CORP.*, Lorain, Ohio., developed for installation of corrugated and flat asbestos products. The Stud Welding insulation pins and speed clips are being handled by *ARMSTRONG CORK CO.*, Lancaster, Pa., for use with industrial insulation materials employed on boiler and power house equipment, ductwork, building enclosures, etc.

Representatives in the north central and eastern states for *ACME INDUSTRIES INC.*, Jackson, Mich., recently convened for the first sales conference held at the home office since 1948. The conference consisted of a tour of the plant and a series of talks and discussions on the latest developments in engineering design and sales of company products. Similar conferences are scheduled for other sections of the country.

An educational campaign designed to enable its industrial distributors to extend their range of service to customers as qualified anti-friction bearing specialists was inaugurated last month by *SKF INDUSTRIES, INC.*, Philadelphia. The program is described by the company as "an extension of its own skilled engineering and trouble-shooting service through the medium of the distributor organization".

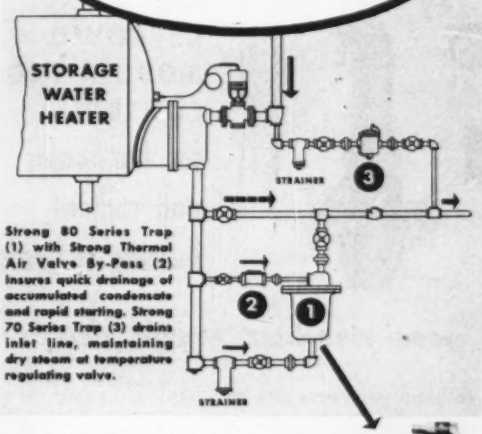
W. W. SLY MFG. CO., Cleveland, has named *HORRELL CO.*, 8006 Melrose Ave., Los Angeles 46, to handle sales engineering for its line of industrial dust control and sandblasting equipment. The southern California firm has been established for a number of years as an engineering consultant and distributor.

An improved electroplating process used in the manufacture of steel pipe couplings has been initiated at the Etna, Pa., plant of *SPANG-CHALFANT DIV., NATIONAL SUPPLY CO.*, Pittsburgh. Before the initiation of the new process, couplings were cleaned, rinsed, plated, dipped in hot, then cold water, and dried. Now, a 0.25 percent solution of nitric acid bath is given the couplings between the hot and cold rinses. This is said to do away with dull finish couplings and to make them cleaner, brighter, and fingerprint proof.

THE TRANE CO., La Crosse, Wis., has prepared a "Ductulator" multiple scaled, circular slide rule for sizing ducts. By setting any known factor to coincide with the known cfm, all other factors, such as friction loss per 100 ft of duct, the diameter of round duct and dimensions of a rectangular duct may be read at a single setting. Recommended and maximum duct velocities for all general installations appear on the reverse side of the calculator, which is available for $1.00 from the company's educational division.

MARBRO MFG. CO., 1620 Lee Rd., Cleveland 18, has recently put on the market the "Gauge Rite" air test unit. The device is a small, light weight gas line tester designed to test gas leaks in ounces. Pressure is built up by squeezing a small aspirator a few times and the gage registers up to 20 oz.

GET *Proper Drainage!*



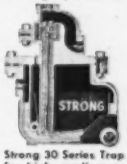
Strong 80 Series Trap (1) with Strong Thermal Air Valve By-Pass (2) insures quick drainage of accumulated condensate and rapid starting. Strong 70 Series Trap (3) drains inlet line, maintaining dry steam at temperature regulating valve.

PROBLEM: Condensate accumulates in coils due to lack of pressure when thermostatic regulating valve is throttling or closed. *Improper drainage and water hammer result when thermostatic valve opens.*

SOLUTION: *Drain coils fast.* Use trap with four to eight times capacity of actual steam condensate rate. For medium or high pressures, either open or inverted bucket traps are suitable. *Use open bucket traps for low pressures.*

Completeness of the Strong trap line enables our engineers to recommend exactly the type or size you need—open or inverted bucket, closed float, float-and-thermostatic (blast), etc., forged, welded, cast or semi-steel construction. Bring your drainage problems to us for solution. Send for Strong Trap Catalog No. 684H today for complete details of *all* Strong traps.

Strong 80 Series Trap for medium or high pressures.



Strong 30 Series Trap for high, medium or low pressures.

STRONG, CARLISLE & HAMMOND COMPANY

1392 WEST 3rd Street
Cleveland 13, Ohio

†Acme Mete

OTHER STRONG STEAM SPECIALTIES

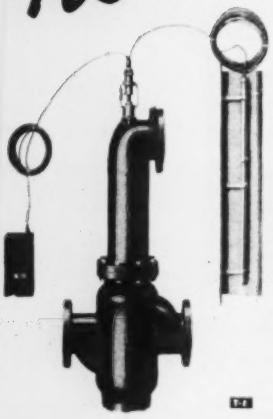
Reducing Valve

70 Series Trap

Strainer

STRONG

It's Here!



THE IMPROVED MODULATING CONTROL for hot water and radiant heating systems

a good product made better-

Sarcotherm engineers are constantly searching for a better product.

While utmost simplicity is still the dominant design principle, the new models now available show many important improvements and refinements.

Double Seated Valves are now used in the larger sizes, greatly increasing valve capacity and permitting smaller valves being used on a given size job. *Convenient manual adjustment* features are now provided in a variety of combinations. *Program control systems* are available to meet any specification.

Easy Installation. New body construction simplifies piping and allows for easy servicing.

Hundreds of successful installations testify to the efficiency of this simple system. Our Engineering Department will be glad to recommend a suitable control system for your particular job.

Ask for new Bulletin ST-501 describing latest improvements.

19A

Sarcotherm

SARCOTHERM CONTROLS INC • Empire State Bldg • NEW YORK 1, N. Y.

C. A. DUNHAM CO., 400 W. Madison St., Chicago 6, has developed an electronic device for detecting leaks in hermetically sealed thermostatic traps. Each thermostatic disc is inserted into a testing chamber and heated to develop internal pressure. A tracer fluid is added to the fluid normally found in each disc. If a leak occurs, it registers on an indicator dial. According to the company, sensitivity tests show that leaks have been detected where less than 1/100 oz of halogen vapors escape in a year's time.

Recent tests and approval by the American Gas Association of its line of blower and duct type gas fired heaters has been announced by *UNITED STATES AIR CONDITIONING CORP.*, Minneapolis. The tests covered blower type units with both steel and cast iron heat exchangers and duct types with cast iron exchangers. The company's complete line of propeller, blower and duct type gas fired heaters is now approved by the association.

A new line of custom-built, pre-engineered switchboards called "Centr-A-Power" has been developed by *TRUMBULL ELECTRIC MFG. CO.*, Plainville, Conn. The switchboards are designed to centralize power and lighting switching in one dead-front, free-standing package. Each unit consists of a series of vertical rigid steel troughs into which are inserted all types of switching devices. All troughs are connected by a continuous power bus which may be fed from the bottom or top of the trough. Individual switchboard units take power from silver plated, vertical bus bars. Each unit is mechanically and electrically isolated from other units in case of faults or short circuits.

A new sub-zero industrial chilling unit, model R-120, designed to conform with the new government low temperature test requirements and for heavy duty operation at —120 F, has been developed by *SUB-ZERO PRODUCTS DIV., DEEPFREEZE DISTRIBUTING CORP.*, 3929 Reading Rd., Cincinnati 9. Insulated with "Santocel", the 10 cu ft chilling chamber is refrigerated by two refrigeration units arranged for cascade operation. The thermal capacity is 2000 Btu per hr at —120 F.

A new instrument designed to control the flow of air over laboratory benches at velocities of 100 ft per min and used in atomic energy laboratories is one of 33 new automatic controls displayed by *MINNEAPOLIS-HONEYWELL REGULATOR CO.*, 2601 Fourth Ave., S., Minneapolis 8, in a coast-to-coast tour. The road show, called the Parade of Progress, will cover more than 60 U. S. cities and will end in the spring of 1952. The purpose of the traveling show is to demonstrate the company's latest electronic, electric and pneumatic control systems.

According to *VERMICULITE INSTITUTE*, Chicago, a recent fire test at the Underwriters' Laboratories of a combination of vermiculite plaster and acoustical plastic ceiling ran 4 hr and 10 min without failure. A feature of the test was that no cracks were visible after exposure for this length of time to a temperature of 2000 F. Immediately afterwards, the ceiling also passed the hose stream shock test for 7 min at about 57 psi.

Almost one million walnut-size "Sterilamps" now are in use freshening indoor areas with electronically-produced ozone, according to the Lamp division of *WESTINGHOUSE ELECTRIC CORP.*, Bloomfield, N. J. Ozone is produced in air by invisible ultraviolet radiations from the four-watt lamp.

Touch-up "Granodine", available from *AMERICAN CHEMICAL PAINT CO.*, Ambler, Pa., is used in a portable process for anchoring paint to cold-rolled steel products, including new work or repaired surfaces of old work. It forms a zinc phosphate coating and can be applied to steel surfaces with hand applicators such as a brush, paint spray gun, etc. It is said to be an ideal preparation for the refinishing of repaired surfaces or for coating work that has not been previously coated, to assure better paint adhesion.

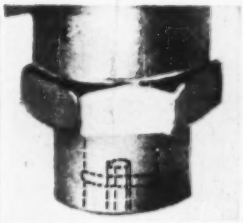
With a twist in the desired direction and a few raps with a hammer, screws, bolts or nuts can be tightened or loosened with a new hand tool named the "Impakdriver". Introduced by *H. K. PORTER, INC.*, Somerville, Mass., it is constructed on a cam principle designed to translate the impact from a hammer blow into torque and is said to be particularly useful for starting stubborn nuts, bolts or screws that are rusted or frozen and to provide a simple means of working in hard-to-get-at places.

A new leather belt with "controlled stretch" designed to prevent permanent elongation of the belt under load and to eliminate slipping has been developed by *S. R. SIKES CO.*, 1028 S. Third St., Minneapolis 15. Called "Cordan", the new belting is reinforced with synthetic cords placed between the leather plies by a special process. These cords are said to provide the added resiliency necessary to prevent the leather from stretching beyond a certain point under load and to return the belt to its true length when not under load. Available in widths up to 24 in., it is said to be waterproof.

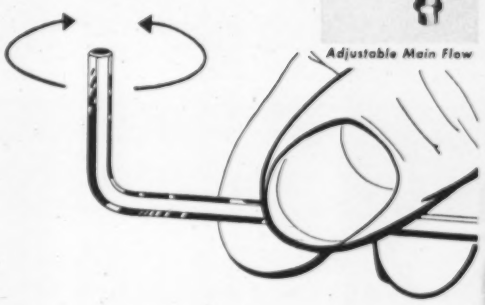
To meet military and commercial requirements for protection against moisture, dust and splashing oil and water, a neoprene "boot" and neoprene side gaskets are now used to seal the metal case of the new type KMXB snap-acting electric switch of *UNIMAX SWITCH DIV., W. L. MAXSON CORP.*, 461 W. 34th St., New York 1. The boot is sealed to the actuating plunger and the entire assembly is integral with the metal case. The neoprene seal is said to retain its flexibility at all temperatures from -65 F to 160 F.

A new portable all-purpose saw is being manufactured by *TRI-SAW CORP.*, St. Louis, Mo. It fits any $\frac{1}{4}$ in. electric drill, can be used with hacksaw blades, and is said to cut directly into floors and walls without a starting hole. It may be used to cut wood, sheet metal, nails, pipe, etc. The distributor is *E. R. PRINCETON & ASSOCIATES*, 2156 W. Diversey Blvd., Chicago 17.

Five new sizes of variable speed combination sheaves have been announced by *SPEED SELECTOR INC.*, 118 Noble Ct. Cleveland 13. The new sizes cover load capacities up to $7\frac{1}{2}$ hp with speed changes up to 7:1. These v belt sheaves are used to produce variations of speed between fixed center shafts. The new 3, 4, 5, 6 and 7 in. single groove sizes are available in two types.



Adjustable Main Flow



Adjustable Oil Burner Automatic Valves

Adjustable By-Pass

The Main Flow adjustment in Bulletin 8281 Valve permits the operator to regulate the flow of oil through the valve when it is open. It's a "regulating" as well as a "Shut-Off" Valve. When de-energized, it closes fully, shutting off the flow completely. It is Factory Mutual Approved.

The By-Pass adjustment in Bulletin 8291 Valve permits a "high or low" flame operation. In other words, the amount of flow can be controlled for full flow or by-pass flow automatically by instrument. It is not a Shut-Off Valve, however, since it does not close completely.

These two ASCO Control Valves are for special cases. Both come in $\frac{3}{8}$ and $\frac{1}{2}$ inch pipe size. Both are suitable for gas, light oil, heavy oil (No. 4, 5, 6 and Bunker C.) air, water and other non-corrosive fluids at temperatures up to 212° F.

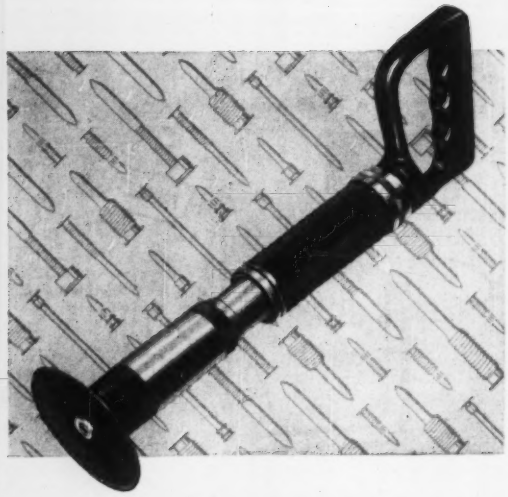
We have other types of Automatic Solenoid Valves for Shut-Off and other purposes not only in the restricted flow types, as these two valves, but in the full flow class. If you will tell us about your automatic control problems, we shall be glad to recommend the proper type.

ASCO Solenoid VALVES

When in need of Automatic Transfer Switches, Remote Control Switches, Contactors, Relays, and Specialized Electromagnetic Controls, come to us.

Automatic Switch Co.

389 LAKESIDE AVENUE · ORANGE, NEW JERSEY



FASTEN INSTANTLY
INTO STEEL OR CONCRETE

with **Ramset** *Dual-Action*

Only RAMSET DUAL-ACTION TOOL gives you a cushioned, fist-grip handle for fast, sure, easy ***turn*** action fastening into steel, concrete, other building materials. In addition, the DUAL-ACTION TOOL offers ***tap*** action fastening—exclusive *dual-choice* of method to suit the work best.

Neoprene handles, easy on the hands, are quickly interchanged. Varying powder charges insure correct penetration with no extra mechanical devices. Widest variety of steel drive pins and studs for practically any job. Strong, precision-built RAMSET TOOL offers unmatched power, flexibility, safety and durability . . . gets work finished on time, at amazing low cost.

TAP IT . . .
or TURN IT

See DUAL-ACTION in ACTION!

Ask your RAMSET Specialist for 15-minute demonstration on your own work. See how RAMSET FASTENING SYSTEM can save you time, money and trouble. RAMSET FASTENERS, INC., *12117 Berea Road, Cleveland 11, Ohio.*

Ramset Fastening System
Pioneer in powder-actuated fastening

WHO'S WHAT

HAROLD K. BECK has been appointed commercial vice president, in addition to his present post as manager of the Washington office, of *WORTHINGTON PUMP & MACHINERY CORP.*, Harrison, N. J. Another new vice president, *AUSTIN C. ROSS*, will continue to serve as Buffalo works manager. *LOUIS G. HILKEMEIER* is now chief engineer of the construction equipment division at Dunellen. He was formerly a construction machinery engineer with the Chain Belt Co.

R. E. MOORE, vice president and secretary of Bell & Gossett Co., Chicago, has been elected to the board of directors of *KROPP FORGE CO. . . . . CALUMET & HECLA CONSOLIDATED COPPER CO. INC.*, has recently elected *HORACE Y. BASSETT* to the board of directors to fill the vacancy resulting from the death of *DUDLEY S. DEAN*.

Mr. Bassett entered the employ of Wolverine Tube Co. in 1939 as quality manager, became general manager of the *WOLVERINE TUBE DIVISION* in 1941, and in 1948 was elected a vice president of Calumet & Hecla. The new commodity sales manager of the tube division is *BUEL A. DEVINE*, who is in charge of tube sales to wholesalers and jobbers.

The new president of the *AMERICAN WELDING SOCIETY* is *HARRY W. PIERCE*, assistant to the president, New York Shipbuilding Corp. He has served on many advisory committees dealing with the investigation of welded stresses in ships, steel for ship construction, and corollary investigations. *CHARLES H. JENNINGS*, engineering manager, welding department, Westinghouse Electric Corp., is the Society's first vice president and *FRED L. PLUMMER*, director of engineering, Hammond Iron Works, is the second vice president for next year.

EDWARD A. LIVINGSTONE, vice president in charge of sales, Babcock & Wilcox Tube Co., has been named to the *STEEL PRODUCTS INDUSTRY ADVISORY COMMITTEE* to advise in the administration of the Defense Production Act as it affects the iron and steel industry. The committee was established by the National Production Authority of the U. S. Department of Commerce.

At a recent board meeting of *ACME INDUSTRIES, INC.*, Jackson, Mich., *E. B. DUNPHY* and *A. B. NEWTON*, were named vice presidents. Mr. Dunphy joined the firm in 1938 and has served in various administrative and managerial posts. He was sales manager from 1942 to 1948. Mr. Newton has been associated with the refrigeration and air conditioning industry for many years. *ALLEN C. DEAN*, formerly sales manager for A. V. Cauhorn Co., is the new Florida representative for Acme.

The *STOKER MANUFACTURERS ASSOCIATION* has established a special committee, the SMA Government Liaison Committee, to act on behalf of the association and the underfeed stoker industry on matters and problems concerning government regulations and legislation. Chairman of the committee is *CLAUDE A. POTTS*, immediate past president of the association and vice president, U. S. Machine Corp.

.... the BEST BUY for

INCREASED ATTENTION and LASTING SALES POWER

THE JANUARY 1951 ISSUE

and 17th Annual Directory Number of

HEATING, PIPING & AIR CONDITIONING

DIRECTORY SECTION . . . .

Every product used in industrial and large building air conditioning, heating and piping will be listed. We'll tell who makes these products and their trade names. All advertisers as they appear in this Directory Section will be prominently identified indicating that more detailed information is elsewhere in the issue. It's the industry's best and most complete BUYING GUIDE—printed on colored stock in a special section.

SHOW SECTION . . . . . .

The January Number will preview the 10th International Heating, Ventilating, and Air Conditioning Exposition, Philadelphia, January 22 to 26. We will cover it completely . . . for those who attend, a *"where to go"* and *"what to see"* Guide—for those who can't go, the highlights of the show in print. Subscribers will get January HP & AC well in advance of the Show's opening date.

STANDARD EDITORIAL CONTENT . . . . . .

January HP & AC will be a "regular issue" in every respect. It will carry a full quota of timely articles, and the Journal Section of the American Society of Heating and Ventilating Engineers—the same as in every issue of this field-leading book. For extra attention value, it will have heavy covers, and be specially mailed.

Here's a regular issue, a directory issue, a show issue—all combined in one great January number . . . . and *no advance* over regular issue rates!

Here your advertising will get *increased attention*, and have *lasting sales power* (as catalog reference copy) throughout all of 1951.

Here is the "best buy" of the year in our field . . . . the place where a convincing sales story of your complete facilities will do you untold good.

Here is where *extra* space for *extra* emphasis belongs!

Most advertisers use increased space with us in January —spreads, inserts, color. They catalog their entire lines. You, too, can profit most by doing a complete job. Make space reservation now . . . . we'll be glad to help with copy preparation if needed.

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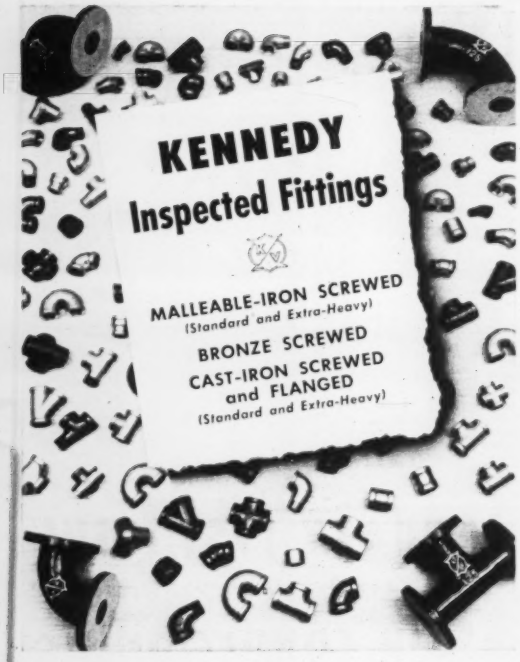

MALLEABLES. Standard and extra heavy. Tough close-grained iron, black or galvanized, precision threaded with generous chamfer for easy pipe entrance. Constantly checked for alignment and depth of thread . . . individually inspected to insure high quality. Hot-dip galvanized for a thoroughly bonded, heavy coating of uniform thickness. High safety factor in service rating.

BRONZE. Durable, long-lived bronze, rough or polished, precision threaded and well chamfered for easy pipe-fitting and thread protection. Individually inspected . . . *each air-tested under water.*

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ELMIRA, NEW YORK
VALVES • PIPE FITTINGS • FIRE HYDRANTS
OFFICE WAREHOUSES IN NEW YORK, CHICAGO, SAN FRANCISCO • SALES REPRESENTATIVES IN PRINCIPAL CITIES

Five new members have been elected to the board of directors of *EUREKA WILLIAMS CORP.* and all company officers have been re-elected. *L. A. CASLER*, Chicago; *F. A. DAUM*, New York; and *M. L. SCHAFER*, New York, succeed retiring members, *E. O. JONES*, Detroit; *F. R. MUENZEN*, New Rochelle, N. Y.; and *C. R. McELHENY*, Bloomington, Ill. The other new board members are *HARRY DIAMOND*, New York, and *FORDYCE TUTTLE*, Rochester, N. Y.

HOWARD L. SPINDLER, manager of advertising and sales promotion for *AMERICAN RADIATOR & STANDARD SANITARY CORP.*, Pittsburgh, is now director of public relations. He has been succeeded by *ROBERT W. LEAR*, formerly assistant manager of the advertising and sales promotion department. . . . . *RALPH S. EULER*, senior vice president, Mellon National Bank and Trust Co., has been elected to the board of directors of *ALLEGHENY LUDLUM STEEL CORP.*, Pittsburgh. His election fills a vacancy created by the recent death of *WILLIAM F. DETWILER*, director and honorary board chairman.

FRED E. HAKER, director of purchases for *ALLIS-CHALMERS MFG. CO.*, Milwaukee, has retired after 50 years of service with the firm. He is succeeded by *KENNETH R. GEIST*, who has served as his assistant for the past two years. Mr. Geist, 32 year old son of the president, started with the company in 1936 . . . . . With headquarters in Edmonton, Alberta, *WAYNE E. WILLIAMS* is the new western district manager for *TUBE TURNS OF CANADA LTD.* He has had 20 years of experience in the petroleum, chemical and power fields.

BUENSOD-STACEY, INC., of New York, Charlotte and Greensboro, N. C., has named *JOSEPH W. KREUTTNER* to the general sales department, with headquarters in New York City. He was formerly vice president and general manager of Air & Refrigeration Corp. and has been engaged since 1924 in the design and installation of air conditioning and refrigeration systems.

A. D. SHEERE is now managing the San Francisco division of *A. M. BYERS CO.*, Pittsburgh. He succeeds *P. D. TABLER*, who has retired. Mr. Sheere joined the firm in 1924 and was formerly manager of the Houston division, which is now in charge of *N. L. BROWN*, formerly field service engineer with the St. Louis division.

CYCLOTHERM CORP., Oswego, N. Y., has announced a number of personnel changes. *JACK HALLANAN* is the new assistant vice president and *E. J. ZISEK* is general sales manager. *R. P. LEONARD* is assistant general sales manager. Mr. Hallanan has been associated with the company in various executive capacities since 1940 and Mr. Zisek was formerly New York City factory branch manager.

JOHN C. RUF, for 10 years Philadelphia district manager for *OHIO INJECTOR CO.*, Wadsworth, Ohio, has retired and is succeeded by *PAUL E. WARNER*. . . . . Newly elected officers of the *INDUSTRIAL MINERAL WOOL INSTITUTE* are: president, and chairman of the board — *E. R. STEVENS*, vice president, Baldwin-Hill Co., Trenton, N. J.; treasurer — *FRANK CHRISTENSON*, of Refractory and Insulation Corp.; vice president — *G. J. CHRISTNER*, of Eagle-Picher Sales Co.; directors — *J.*

"I believe every company should..."

MR. CLARENCE FRANCIS

Chairman of the Board, General Foods Corporation

"I believe every company should conduct a person to person canvass right now, for the best way to promote the sale of U. S. Savings Bonds is to put an application card into each employee's hand and allow him to reach his own decision."

As one of America's top executive salesmen, Mr. Clarence Francis knows that you sell more when you "ask the man to buy." Naturally, that means a person to person canvass of *all* your employees, but it is not as difficult as it may sound. In fact, it is very simple:

Tell your employees personally—or over your signature—why the automatic purchase of Savings Bonds through the Payroll Savings Plan is good for them and their country.

Designate your Number One Man to organize the canvass and keep it moving.

Enlist the aid of employee organizations—they will be glad to cooperate with you.

With posters, leaflets, and payroll envelope enclosures remind your employees of the many benefits of the Payroll Savings Plan. Your State Director, U. S. Treasury Department, Savings Bonds Division, will furnish you, free of charge, all the promotional material you can use.

Be sure that every man and woman on the payroll is given a U. S. Savings Bond Application Form.

Thousands of companies, large and small, have just completed or are now conducting person to person canvasses. Their reports are a challenge to every company that does not have a Payroll Savings Plan . . . 50% employee participation . . . 60% employee participation—some of them have gone over 80%.

All the help you need to conduct your person to person canvass is available from your State Director, U. S. Treasury Department, Savings Bonds Division. Get in touch with him.

The U. S. Government does not pay for this advertising. The Treasury Department thanks, for their patriotic donation, the G. M. Basford Company and

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Control panel box
. . . . Dust tight, damp proof panel box is located on front of heater within sight and reach of all burner adjustments. Thermostatic and safety controls operate on 110 volt current from transformer in control box.
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DIRECT FIRED HEATERS
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S. BLUNT, of Holmes Foundry Co. Ltd.; *J. A. BUETTGEN*, of M. H. Detrick Co.; *M. W. BUTLER*, of Owens-Corning Fiberglas Corp.; and Mr. Christner.

SHANNON C. POWERS is now general sales manager of *RUSSELL ELECTRIC CO.*, a Chicago subsidiary of *RAYTHEON MFG. CO.* Both before and after World War II he was associated with General Electric Co., resigning from the apparatus department recently to join the sales department of Russell Electric.

The newly elected president of the *PRODUCERS' COUNCIL*, national organization of building products manufacturers, is *A. NAUGHTON LANE*, vice president, Monarch Metal Weatherstrip Corp. He succeeds *JAMES M. ASHLEY*, of Libbey-Owens-Ford Glass Co. . . . The recently named advertising and sales promotion manager of *MITCHELL MFG. CO.*, Chicago, is *HOWARD G. HAAS*. He was formerly assistant advertising manager.

FRANK U. HAYES, sales manager, *BULLARD CO.*, Bridgeport, Conn., has been elected a director of the firm and succeeds *E. P. BLANCHARD*, formerly director of sales, who has retired after 30 years with the company . . . . . *JACK CHERRY*, who has been with *PHILCO CORP.*, Philadelphia, for 16 years and has been general manager of the accessory division for the past year, is now sales manager of air conditioning and freezers. In his new capacity he is responsible for the sale of room air conditioners.

LINK-BELT CO., Chicago, has named *BERTRAM V. JONES*, advertising manager, to succeed *JULIUS S. HOLL*, deceased. *JOHN F. KELLY* continues as assistant advertising manager. Mr. Jones joined the company's advertising department in 1923. . . . *WILLIAM A. MARSTELLER* has resigned as vice president of Rockwell Mfg. Co., Pittsburgh, and as vice president and a director of Edward Valves, Inc., East Chicago, Ind., to form his own advertising and marketing consulting firm, with headquarters in Chicago.

EMANUEL FEINBERG is now factory representative for *McQUAY INC.*, Minneapolis, in the Detroit and Toledo areas. He was associated for several years with Giffels & Vallet, Inc., as an industrial engineer, and was with American Thermal Industries. He was also director of sales for Acme Industries, Inc., and is currently heading *THERMALAIR ENGINEERING CO.*, 6432 Cass Ave., Detroit. Through this office he will handle the company's complete line of heating and air conditioning equipment.

Three new field representatives have been added to the sales staff of the temperature controls division of *PERFEX CORP.*, Milwaukee. *HUGH C. CAMERON*, 2101 Park Ave., Indianapolis, formerly a sales engineer with Lustron Corp., is district manager for the state of Indiana. Formerly associated with F. S. Stokes Machine Co. and White House Chemical Co., *HUGH H. HACKETT, JR.*, 127 E. 61st St., New York City, is serving as district manager for the states of Pennsylvania, Maryland, and Virginia. *WILLIAM P. McDOWELL* has been assigned to the task of appointing and training new distributors throughout the country. He will headquarter in Columbus, Ohio.

BRYANT HEATER DIV., AFFILIATED GAS EQUIPMENT, INC., Cleveland, has opened a branch office

Send for This Useful Reprint Volume

"CORRECT PRACTICE in INDUSTRIAL PIPING"

197 Pages — 8½" x 11" — $1.50

This practical book is made up of outstanding papers and data on industrial piping selected from past issues of "Heating, Piping & Air Conditioning." It is a most comprehensive collection of case studies, showing how various difficult piping problems encountered in different industrial plants were successfully worked out by piping experts.

Design, installation, operation, and maintenance . . . steam, air, gas, oil, process, water and refrigeration piping . . . piping in pulp and paper and steel mills, in automobile plants and breweries, in the food and chemical and textile industries, and in many other types of manufacturing plants are dealt with from many different angles.

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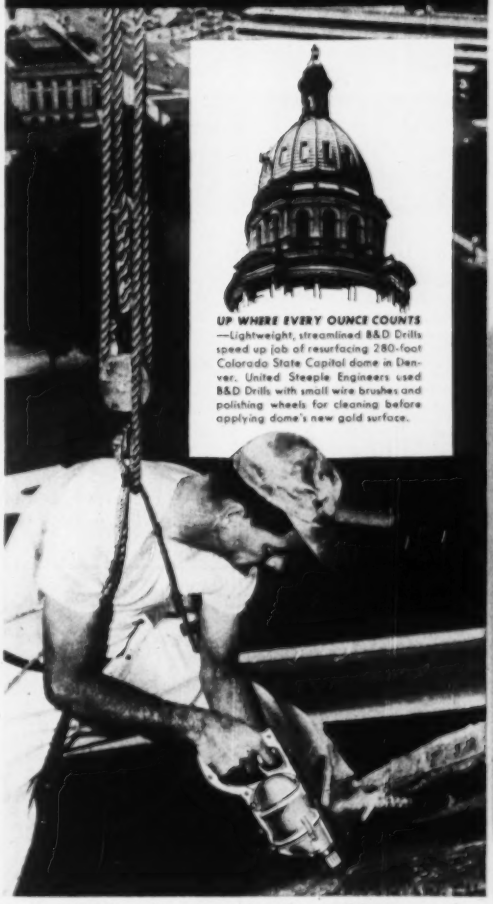


UP WHERE EVERY OUNCE COUNTS —Lightweight, streamlined B&D Drills speed up job of resurfacing 280-foot Colorado State Capitol dome in Denver. United Steeple Engineers used B&D Drills with small wire brushes and polishing wheels for cleaning before applying dome's new gold surface.

MAYBE you'll never work under conditions as tough as these. But you'll still want the compact power of Black & Decker Drills whenever you're working in close quarters or doing overhead jobs!

For example, take the three *new* B&D Drills—the ¼" Heavy-Duty, 5/16" Heavy-Duty and ⅜" Standard models. Their improved housings give you a better grip. Light weight cuts fatigue. And the B&D ⅜" Standard Drill is ideal for sheet metal shops because it has extra chuck capacity, *plus* the right speed for driving many of the cleaning, polishing and cutting attachments you use.

See your nearby B&D Distributor for demonstrations. Write for free catalog to: The BLACK & DECKER MFG. CO., 628 Pennsylvania Ave., Towson 4, Md.

LEADING DISTRIBUTORS EVERYWHERE SELL

B&D *Black & Decker*
PORTABLE ELECTRIC **TOOLS**

SHEARS • HAMMERS • SANDERS • BENCH GRINDERS

in Detroit. Located at 617 Central Detroit Warehouse, 10th and W. Fort Sts., it is being managed by *J. H. SWALLOW*, formerly southern district sales manager. Formerly with the Detroit Gas Company, he will confine his operations to St. Clair, Macomb, Oakland, Wayne and Monroe counties. *CHARLES LOCKHART*, formerly his assistant, now becomes southern district sales manager with headquarters in Dallas.

J. NEIL BROPHY has managed burner activities in New England since 1938 (except for two years with the War Production Board as chief engineer of its conversion division) for *ENTERPRISE ENGINE & MACHINERY CO.*, San Francisco. He is now eastern factory representative for the company's oil burner division.

R. H. WEIGEL has joined *NATIONAL RADIATOR CO.*, Johnstown, Pa., as a senior research engineer. He was formerly a special research assistant at the University of Illinois where for the last three years he participated in the heating system research program sponsored by the Institute of Boiler and Radiator Manufacturers.

JOHN M. DOOLEY is handling National Radiator's sales representation throughout eastern Tennessee and is associated with the branch sales office at 308 E. Cary St., Richmond, Va. He had been associated with Southern Coal & Coke Co. and, since 1945, was an electrical engineer on the staff of the Knoxville, Tenn., utilities board.

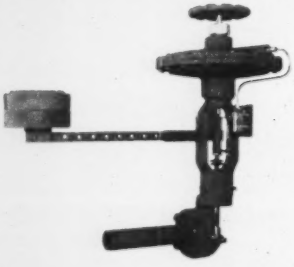
EDWARD VALVES, INC., East Chicago, Ind., has appointed *JOHN E. STEVENS, JR.*, assistant to the president. He was formerly vice president of Bergen Genspring Corp. and previously had been assistant manager of engineering for M. W. Kellogg Co. He was formerly in sales engineering with Eagle-Picher Co. and Sarco Co. Inc.

THOMAS E. SKILLING is now Pittsburgh district sales engineer and, as Edward representative in that area, he succeeds Herr-Harris Co. Mr. Skilling was in the company's home office engineering and sales work since 1947 and has been associated with Herr-Harris for several months. He will continue his office at 515 William Penn Pl., Pittsburgh.

As the new southeastern representative for *DRESSER MFG. DIV., DRESSER INDUSTRIES INC.*, Bradford, Pa., *HENRY F. PEEBLES* will cover the states of Florida, Georgia, North and South Carolina, Kentucky, Mississippi, Virginia, Alabama, and Tennessee. He will also work with certain customers in Indiana. He has been with the company about two years.

JOSEPH M. FOX, formerly safety engineer of *SHARP & DOHME, INC.*, Philadelphia, is now waste control engineer. The new position, which was created by the company move to consolidate its three Philadelphia plants, will include operation of waste treatment and disposal facilities, control and elimination or recovery of waste and pilot work. He joined the firm as a junior chemical engineer in 1946.

The new chief engineer for *TECHNIFLEX CORP.*, Port Jerris, N. Y., is *JOSEPH ASKIN*. He was chief engineer for Fedders Mfg. Co. for 20 years and later served as



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For SERIES 14 CONTROL

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THE WEBSTER ENGINEERING CO.

P. O. BOX 2168 TULSA, OKLAHOMA

chief engineer for Peerless of America, Inc., and he has also been chief engineer of Electrimatic Div., Simoniz Corp. of America.

E. F. DREW CO., INC., New York City, has appointed *JAMES QUIGLEY*, *JAMES DEVINE*, and *CHARLES T. MONROE* as laboratory technicians in its power chemicals division. These men, chemical engineers with considerable experience in the boiler water treatment field, are assigned to the laboratory service which is offered to users of the company's chemicals.

FRED K. LADEWIG, who joined *THE TRANE CO.*, La Crosse, Wis., in 1946, is now manager of the company's Kansas City office. *E. A. CLINE*, a veteran of 30 years with the company, has decided to retire as manager to devote his time to other duties within the office ..... *AIR-TEMP DIV., CHRYSLER CORP.*, Dayton, Ohio, has transferred regional managers as follows: *FRED J. LAUGHNA*, from Detroit to Chicago; *RALPH W. STEINBAUGH*, from Chicago to St. Louis; *HOMER D. DAY*, from St. Louis to Boston; and *JERRY A. CLARKE*, from Boston to Detroit.

GEORGE GABRIEL, who has been plant engineer at the Mertztown plant of *ATLAS MINERAL PRODUCTS CO.*, has been promoted to assistant plant manager..... *J. C. WHITLAM MFG. CO.*, Wadsworth, Ohio, has appointed three new representatives. *JAMES P. WALKER*, 1867 S. W. 18th St., Miami, Fla., is now handling representation in that state. *CALVIN CARR*, Kalamazoo, is covering the entire state of Michigan, and *COCHRAN & CO.*, Atlanta, is the representative for the Georgia and South Carolina territory.

Studies Heating and Cooling Media Other Than Water

In his paper, Heating and Cooling Media Other than Water, D. G. Lewis points out that the number of liquids available for heating or cooling purposes is increasing and those already available provide a liquid temperature range at atmospheric pressure up to 600 F. The author outlines some of the qualities such liquids should possess for comfort heating and cooling purposes and considers their physical properties in terms of these requirements. The characteristics and pertinent physical properties of certain liquids are briefly described and reference is made to possible limiting factors. From an examination of these properties the possibilities of using various liquids in the common types of heating systems are analyzed.

Mr. Lewis discusses such liquids as brine, glycerine, ethylene glycol, chorinated biphenyls, a mixture of diphenyl and diphenyl oxide, mineral oil, tetra aryl silicates, mercury, and ethylene glycol and concludes that water will continue to be used in all centralized systems for comfort heating and that suitable liquids other than water will find a wider scope for industrial heating purposes where high temperature heating surfaces are essential.

This paper was presented at the recent summer general meeting of the Institution of Heating and Ventilating Engineers, 75 Eaton Pl., London, S.W. 1, England.

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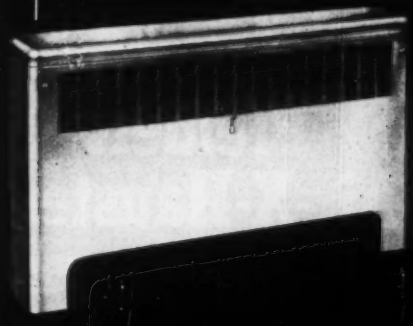
CONVECTORS



Attractive appearance, outstanding performance, and ease of installation have led to an increasing preference for Airtherm Convectors in institutions, apartments, homes and schools. Try AIRTHERM Convectors on your next job.

Airtherm Cabinet design permits quick, easy assembly.

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FOR HEATING SATISFACTION...

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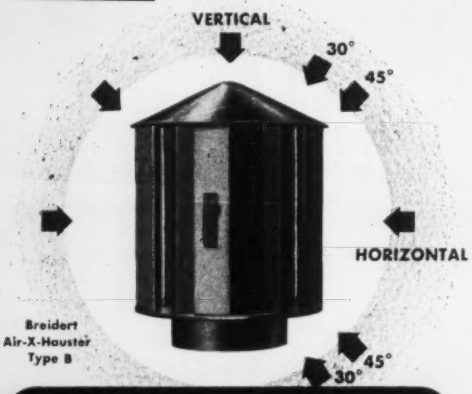

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The Revolutionary Improvement in Roof Ventilators and Chimney Tops

Only the Breidert Air-X-Hauster offers certified capacity ratings based on tests* made with wind blowing in ALL directions as shown above. Only such tests can guarantee the capacities a ventilator will deliver under actual operating conditions! No matter which way the wind blows, barring interior negative pressures, the Breidert provides safe, sure ventilation.

For Chimney Tops . . . the Breidert Air-X-Hauster stops down-draft, exhausts smoke and fumes, completely overcomes sluggishness caused by down-draft. Thousands of Breiderts are in use all over the country.

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Send for ***FREE***

ENGINEERING DATA BOOK . . .
use the coupon for complete information on the Breidert Air-X-Hauster, including certified capacity ratings.
*By Smith, Emery & Co. of San Francisco, Pacific Coast Branch of the Pittsburgh Testing Laboratory.

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NEW BOOKS & REPORTS

Air Conditioning, Heating, Ventilating Text Enlarged

The second edition of Modern Air Conditioning, Heating and Ventilating, by the late Willis H. Carrier, who was chairman of the board of directors, Carrier Corp., together with Rialto E. Cherne, consulting engineer, and Walter A. Grant, director of research, Carrier Corp., is now off the press. According to the authors, it is not intended to supplant texts on the physics and thermodynamics of air conditioning, but rather to complement them —to lead the reader into the channels of thought which are the prime interest of those intimately connected with the industry.

The new edition incorporates thorough revisions of many sections in which progress in the art has made notable strides in the past 10 years. Important changes and additions have been made to material dealing with oil burner application, panel heating, air cleaning and purification, cooling coils, a functional analysis of central air conditioning systems, and automatic control. In addition, many improvements have been made toward clearer presentation for better understanding. The section on psychrometrics has been entirely rewritten and includes the new Carrier psychrometric chart. New data have been added on the subjects of comfort, refrigeration, and to the appendix. Also noteworthy are the problems which have been added covering both the theoretical and practical aspects of the subject matter. The 21 chapters deal with such subjects as psychrometrics and comfort, estimating requirements, economics, heat producing and heat distributing equipment, automatic controls and zoning, fans, heaters, ventilators, air cleaning devices and humidifiers, the design of air duct systems, cooling and dehumidification, central and unit systems, refrigeration systems and equipment, refrigeration piping, air distribution and zoning, noise and vibration, and application practice.

Containing 574 pages, this 7 × 10 in. clothbound book is published by Pitman Publishing Corp., 2 W. 45th St., New York 19, and is priced at $10.00.

Gives Data for Design of Snow Melting Systems

Snow Melting is the title of a new treatise by T. Napier Adlam, vice president, Sarco Mfg. Corp. and consulting engineer, which deals with the design, installation, and control of systems for melting snow by hot water coils imbedded beneath walks, roads or other areas.

The book not only covers the design of systems but includes detailed tables on the amount of snowfall in 270 cities and covers air venting, pipe friction, pump selection, and cost of installing, and operating. Three chapters are devoted to descriptions and illustrations of installations already in operation. Special attention is given to the calculation of heat requirements, pipe friction and expansion, and antifreeze solutions and their use in snow melting systems. The design procedure given utilizes 27 charts for pipe sizing and spacing.

Priced at $4.50, the book contains 221 pages, is clothbound, and is published by The Industrial Press, 148 Lafayette St., New York 13.

Reports on Tests of High Temperature High Pressure Pipe Joints

The paper, Joints For High Pressure High Temperature Piping, by I. H. Carlson, research supervisor, and W. S. Black, research engineer, Crane Co., outlines the difficult problem of obtaining leakproof joints for high pressure high temperature piping. It includes the results obtained from tests on three full-size joints for connecting ferritic alloy main steam piping to austenitic alloy turbine equipment of 150,000 kw capacity.

Joints tested included the pressure seal joint which utilizes the fluid pressure acting against the full gasket circle area to obtain its sealing force between the conical surface of the stub end and the cylindrical surface of the socket flange (assisted by moderate initial bolt loading in the case of joints subjected to bending loads or operating on vacuum or low pressure service); the bellows type gasket which is intended to care for both axial and radial relative movements of the opposed flange faces; and the spiral wound gasket joint made by remachining the bellows type joint flanges to accommodate the spiral wound metal, asbestos filled gasket.

The special 10 in., 1900 lb pressure seal flanged pipe joints remained tight throughout 25 cycles of heating to 1050 F and quenching with saturated steam at approximately 575 F. The special 10 in. 1900 lb bellows type flanged pipe joint leaked 11 times out of a total of 23 quench tests. The amount of leakage was extremely slight and the length of time of leakage varied from 15 sec to 8 min. The joint sealed itself in every case. Performance of the special 10 in. 1900 lb spiral wound metal, asbestos filled gasket flanged pipe joint in this application was unsatisfactory. During the first quench the spiral wound gasket leaked moderately for 15 min after which time the joint sealed itself. During the second quench the joint leaked severely.

Detailed information on the tests is given in this paper (No. 50-F-32) presented at the recent fall meeting of the American Society of Mechanical Engineers, 29 W. 39th St., New York 18.

Issues Standard for Testing, Rating Air Conditioners

The American Society of Refrigerating Engineers has released a new standard for testing and rating air conditioners (16R) which covers self contained air conditioners, room conditioners, remote type conditioners, heat pumps, and oil and gas fired conditioners. It consists of a revision of two former ASRE standards, namely No. 16, Methods of Rating and Testing Self Contained Air Conditioning Units for Comfort Cooling (1940), and No. 13, Methods of Rating and Testing Air Conditioning Equipment (1936).

An innovation provided in the new standard is the use of the calibrated room calorimeter which is designed primarily for testing room air conditioners of the free delivery type. Inasmuch as this calorimeter requires no attachments to air inlets or outlets, it avoids the possibility of influencing the ratings, as might be the case where attachments are applied to certain types of units.

Owing to the fact that this device is not generally available for use, September 1951 has been recommended as the effective date for that portion of the standard relating

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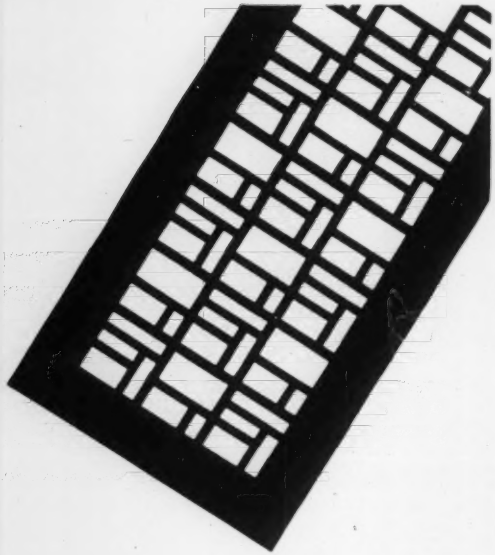
Write for your free copy of "Heat Insulation For Industry." Address your request to Dept. H-12, The Philip Carey Manufacturing Company, Cincinnati, 15, Ohio. In Canada: The Philip Carey Company, Ltd., 1557 MacKay Street, Montreal 25, P.Q.



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to free delivery room air conditioners. In the meantime, use of the psychrometric calorimeter is recommended as an alternate method of testing.

Copies of the standard may be obtained from ASRE headquarters, 40 W. 40th St., New York 18, for $1.00.

Revises Code for Testing and Rating Steam Unit Heaters

Bulletin No. 10, the Standard Code for Testing and Rating Steam Unit Heaters, second edition, has been released by the Industrial Unit Heater Association, and supersedes the first edition of 1930.

The fundamental engineering has not been changed. Improved testing equipment, instruments and techniques have been developed through the years and the purpose of this edition is to recognize them.

Copies may be obtained without charge from association headquarters at 2159 Guardian Bldg., Detroit 26.

Describes Methods of Heat and Temperature Measurement

Heating and Temperature Measurement, by Robert L. Weber, associate professor of physics, Pennsylvania State College, describes measurement methods and includes the theoretical principles necessary for their appreciation, intelligent use, and extension.

Part I presents the physical principles which serve as a basis for thermal measurement. It covers temperature scales, expansion thermometers, heat transfer, thermoelectricity, thermoelectric temperature measurements, radiant energy, optical and radiant pyrometry, resistance thermometry, temperature recording and control, calorimetry, thermodynamics, phase diagrams, extreme temperatures, and special methods of temperature measurement. Part II outlines the procedures for 29 laboratory experiments. Brief discussions of the theory and photographs of typical arrangements of apparatus should be helpful in planning experiments and in setting up the apparatus. According to the author, the material will appropriately follow an introductory physics course and is suitable for a one semester college course in which lecture-recitation and laboratory work are integrated. The emphasis is on experimental methods rather than on thermodynamic theory.

Published by Prentice-Hall Inc., 70 Fifth Ave., New York 11, the 122 page book is clothbound and is priced at $6.65.

Revises Refrigeration Text

Shortly before his death, Prof. H. J. Macintire discussed plans for a revised and expanded edition of his text, Refrigeration Engineering, with Prof. F. W. Hutchinson, of the University of California, who has prepared the new second edition.

Since this book has been widely used both as a college textbook and as a reference book for practicing engineers, it has been revised to increase its effectiveness for both of these purposes. One half of the material in the book is entirely new. Eight chapters have been added, over 70 additional illustrations are included, and there are some 200 problems of which 160 are new.

For use as a textbook, it has been strengthened by expansion of the section on reverse cycle theory (from two

to eight chapters), by regrouping of chapters to form four rationally organized sections on theory, load, equipment, and application. For use as a reference book, it has been strengthened by the inclusion of much new material. An extensive discussion of the analysis of transient phenomena in refrigeration is included. Such phenomena include pulldown, subcooling and delayed heat-up through use of partial load emergency equipment. Over 30 full-page graphical solutions are provided giving direct reading values of the film coefficients of heat transfer for most of the commonly used refrigerants when being heated or cooled as either a subcooled liquid or a superheated vapor. The heat pump is treated both from the standpoint of thermodynamic cycle analysis and from the standpoint of transient heat flow problems associated with energy sources and energy sinks. A chapter has been added covering the influence of radiation effects and determination of equilibrium cold storage temperature, and a detailed design procedure is included for comfort panel cooling systems.

Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, this clothbound text contains 610 (6 × 9¼ in.) pages and is priced at $6.50.

Other Books & Reports Received

GALVANIC CORROSION OF DISSIMILAR METALS AS APPLIED TO GAS HOT WATER STORAGE HEATERS—PART III—A 27 page paper covered booklet published by the American Gas Association, 420 Lexington Ave., New York 17. Results of attempts to stop galvanic corrosion in seventeen 30 gal gas fired water heaters and in thirty-two 700 ml tanks are presented. Tests on the larger tanks were conducted with zeolite softened Cleveland water, whereas tests on the smaller tanks were conducted with this same water as well as with distilled water and distilled water plus 50 ppm free CO_2. Chemical analyses of the influent and effluent water were made, and photographs are used to compare the relative protective ability of silicates, phosphates, magnesium anodes and dielectric pipe fittings.

The research was conducted at Case Institute of Technology and was sponsored by the AGA.

METHODS IN CLIMATOLOGY, second edition, by V. Conrad, research associate in climatology, Harvard University, and L. W. Pollak, director, School of Cosmic Physics, Dublin Institute—This revised edition has been enlarged and deals systematically with climatological problems, giving mathematical tools for their specific analysis. It presents fundamentals of mathematical statistics, nomograms, and alignment charts, curve fitting, smoothing of numerical series, harmonic analysis, and correlation. Considerable emphasis is given to the problem of homogeneity of climatological series. A new section, Part II, begins with a discussion of mechanical aids to computation in the handling of large numbers of observations, and also covers exact methods for discovering hidden periodicities and testing the reality of the results obtained. It is published by Harvard University Press, 44 Francis Ave., Cambridge, Mass., contains 159 pages, 101 tables, 115 illustrations, and is priced at $7.50.

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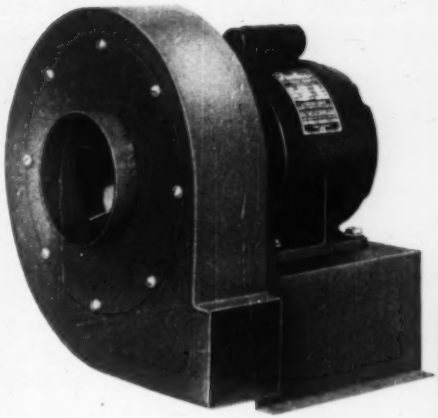

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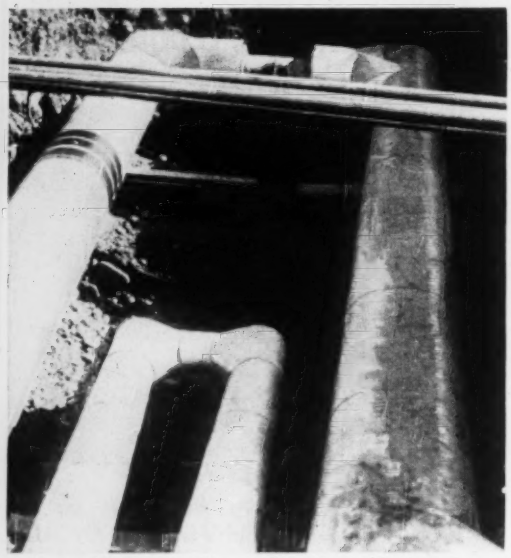

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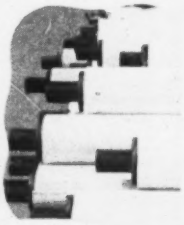

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MEETINGS & CONVENTIONS

6th ANNUAL SOUTHWEST AIR CONDITIONING CONFERENCE—To be held December 11 to 13, University of Texas, Austin, Tex.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, 1515 Massachusetts Ave., N.W., Washington 5, D. C.—The 117th meeting of the association will be held December 26 to 30, in Cleveland. All 17 of the association's sections and subsections and more than 40 participating societies and organizations are completing plans for an aggregate of more than 200 sessions. The annual Science Exposition will be held concurrently in the Cleveland Public Auditorium.

Housing will be taken care of by the Cleveland Convention Bureau, with hotels confirming reservations directly. Convention hotels include the Statler (AAAS headquarters), Hollenden, Carter, Allerton, Olmsted, and Auditorium.

PLANT MAINTENANCE SHOW and CONFERENCE, to be held January 15 to 18 in the Cleveland Auditorium. Advance registration cards and hotel information may be obtained from Clapp & Poliak, Inc., 341 Madison Ave., New York 17, show manager.

A plant maintenance conference, to be held during the first three days of the show, will include discussions of power plant and heating equipment, lubrication, and electrical equipment. Exhibits at the show will include heating, ventilating, and air conditioning equipment. Some 15 speakers will address the conference which, together with the show, is being sponsored jointly by the American Society of Mechanical Engineers and the Society for the Advancement of Management.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, 51 Madison Ave., New York 10—The 1951 annual meeting will be held in Philadelphia, January 22 to 25. Registration and technical sessions will be at the Bellevue-Stratford hotel, other meeting functions at the Benjamin Franklin and Warwick hotels. For additional information, see page 128.

10th INTERNATIONAL HEATING, VENTILATING AND AIR CONDITIONING EXPOSITION—Under the auspices of the American Society of Heating and Ventilating Engineers, the show will be held January 22 to 26, Commercial Museum, Philadelphia. International Exposition Co., 480 Lexington Ave., New York City, is managing the affair.

STANDARDIZATION SEMINAR—To assist manufacturing organizations in their standardization work, a private five-day seminar will be held by Dr. John Gaillard, mechanical engineer, American Standards Association, and lecturer at Columbia University. The dates are January 22 through 26 and the place is room 501-A, Engineering Societies Bldg., New York City. Ten conferences are scheduled and additional information may be obtained from Dr. Gaillard at 400 W. 118 St., New York 27.

INTERNATIONAL ENGINEERING CONFERENCES AND EXHIBITION—International meetings to be held in India during January are the Fourth Congress on Large Dams, the sectional meeting of World Power Conferences, the meeting of the International Association of Hydraulic Research, and a conference of the newly formed International Commission on Irrigation and Canals. An exhibition of engineering activities in these fields will be held at the same time. Additional information may be obtained from the Consulate General of India, 3 E. 64th St., New York 21.

HEATING SHORT COURSES—Two "engineering institutes", on the pattern of short courses, will be held at the University of Wisconsin. Sessions on steam and hot water heating will be held February 13 to 15 and classes scheduled for March 13 to 15 will cover warm air heating and air conditioning. Enrollments are limited and additional information may be obtained from Prof. H. E. Pulver, University Extension Division, Madison, Wis.

AMERICAN SOCIETY FOR TESTING MATERIALS, 1916 Race St., Philadelphia 3—National meetings scheduled for 1951 are the spring meeting and committee week, March 5 to 9, Cincinnati, and the annual meeting, June 18 to 22, Atlantic City. The 1952 spring meeting and committee week will be held, March 3 to 7, in Cleveland and the 1952 annual meeting is scheduled for June 23 to 27 in New York City.

INTERNATIONAL INDUSTRIAL EXPOSITION—March 11 through 17, the Coliseum, Houston, Tex. According to the exposition management, located at 41 San Jacinto St., Houston 2, exhibits will cover oil, refining, chemicals, metals, machinery, power, material handling, welding, and instruments, as well as electrical, safety, and marine equipment.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS, 919 Milam Bldg., Houston, Tex.—The 1951 conference and exhibition will be held at the Hotel Statler, New York City, March 13 to 16, and plans are now underway for the presentation of 39 technical papers.

AMERICAN FOUNDRYMEN'S SOCIETY, 616 S. Michigan Ave., Chicago 5—The 55th annual convention will be held in Buffalo, N. Y., April 23 to 26.

MATERIALS HANDLING EXPOSITION—International Amphitheater, Chicago, April 30 to May 4. Industries which will be given special attention in exhibits include, paint and varnish, oil, chemicals, and food processing. Simultaneously with the show, which is sponsored by the Material Handling Institute, a three-day conference will be conducted by the American Material Handling Society. Advance registration cards and hotel information may be obtained from the show manager, Clapp and Poliak, Inc., 341 Madison Ave., New York 17.

AIR POLLUTION AND SMOKE PREVENTION ASSOCIATION OF AMERICA—The 1951 annual meeting will be held May 6 to 10, Roanoke, Va.

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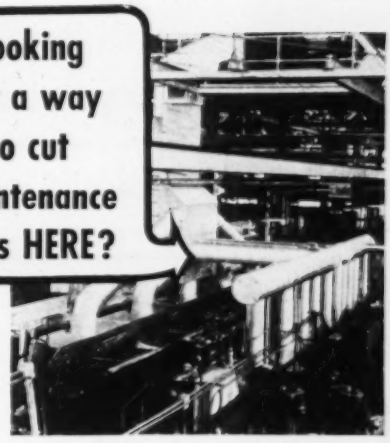

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Brewing	Laboratory	Rubber
Canning	Laundry	Shipbuilding
Ceramic	Leather	Shoe
Chemical	Match	Smelting
Dairy	Meat Packing	Soap
Drug	Metal	Soft Drink
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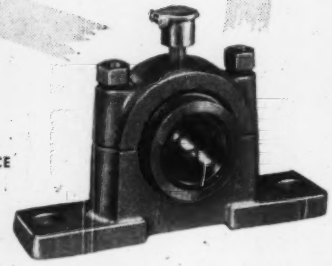

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Bimetal Strip Thermostats

HPAC 101—A new bulletin describing type S bimetal strip thermostats for use in appliances and industrial apparatus is available from Stevens Mfg. Co., Inc., Mansfield, Ohio. It includes photographs of 13 standard models, schematic diagrams showing operating principles, dimensions, and typical thermostat response curves.

Coatings and Linings

HPAC 102—The "Lithcote" protective coatings and linings of Lithgow Corp., 36 W. 44th St., New York 18, are basically a baked on phenolic resin coating applied by spraying multiple coats of a solvent solution. A new bulletin describes many corrosion applications, including storage, measuring, fermenting, and mixing tanks, dryers, exhaust fans, pumps, agitators, valves, etc.

Corrosion Resistant Coatings

HPAC 103—Corrosion resistance superior to conventional zinc coatings with cost savings is claimed for "Zincilate", a one coat, self protecting, anti-corrosion coating. It is described in an eight page illustrated bulletin issued by Industrial Metal Protectives, Inc., 401 Homestead Ave., Dayton 8, Ohio. The bulletin features case histories, gives specifications for two formulations, and provides data on surface preparation and methods of application.

Dye Penetrant Inspection

HPAC 104—Dy-Chek Div., Northrop Aircraft, Inc., 1515 E. Broadway, Hawthorne, Calif., is now issuing monthly letters to provide an interchange of technical information on the company's dye penetrant method of inspection. Bulletin No. 503 briefly mentions the determination of hairline cracks in stainless steel, finding defects in weldments, and steel inspection after heat treatment.

Electric Motor Bearing Design

HPAC 105—Reliance Electric & Engineering Co., 1088 Ivanhoe Rd., Cleveland 10, has released Bulletin B-2201 on its prelubricated bearing design. The folder contains descriptive sketches, cutaway drawings of the improved double shielded bearings and their bracket mounting, and a check list which compares other bearing arrangements with the company's design.

Flame Hardening Equipment

HPAC 106—Descriptions and illustrations of its latest flame hardening equipment are contained in a new 20 page catalog released by Air Reduction Sales Co., Div. of Air Reduction Co., Inc., 60 E. 42nd St., New York 17. Gas control equipment and pipe line systems are covered, and recommendations for the production flame hardening of special shapes are given.

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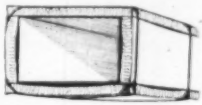

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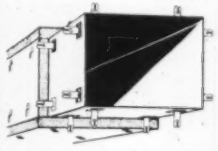

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- Stic-Klips hold insulation mechanically in compression.
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and other applications which HAVE proved that this modern method of snow removal

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—and because snow melting by pipe coils has other distinct advantages, such as dirt-free sidewalks and entrances, and the complete elimination of ice surfaces, the demand for this method of snow removal is swiftly growing.

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AIR CONDITIONING ENGINEERS: At least 7 years' experience in selection and operation of heating, air-conditioning, ventilating and refrigeration equipment. Well versed in the theory of thermodynamics, fluid flow and heat transfer. For consulting evaluation, and economic operation services. Must be graduate.

MAINTENANCE ENGINEERS: Five to ten years in planning maintenance work, establishing manpower and material requirements, scheduling and controlling work. Must be thoroughly familiar with Machine and Hand Tools used in Plant Maintenance Work. Must have supervised persons doing maintenance work. Must be graduate. For consultation work.

HEATING AND VENTILATION ENGINEERS: Eight to ten years progressively difficult experience in field and office problems in heating, ventilating and air-conditioning design. Also, experience in making economical evaluation of alternate methods. Must be graduate.

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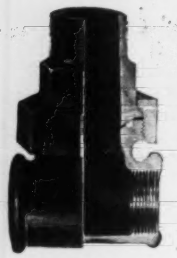

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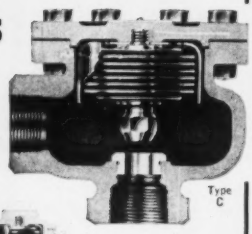
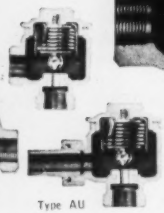


Type A



Type AHV

Type AU

Type C

Because they drain completely when cold, these four types of Nicholson steam traps are positively freeze-proof. Can be freely installed outdoors. Universally recommended for use in lines which need not be in continuous use during cold weather, because they are freeze-proof and because their 2 to 6 times average drainage capacity results in minimum heat-up time. The non-air-binding feature of Nicholson traps also notably facilitates steam transfer in severe weather. Size ¼" to 2"; press. to 225 lbs.

BULLETIN 450

W. H. NICHOLSON & CO.
198 OREGON ST.
WILKES BARRE, PA.

Valves ★ Traps ☆ Steam Specialties

Flexible Hose Lines

HPAC 107—Bulletin No. 113 of Aeroquip Corp., Jackson, Mich., describes and illustrates the company's industrial hose and fittings. Instructions on assembling fittings to hose lines are given and detailed information is included on the company's self sealing couplings and breakaway couplings.

Gearmotor

HPAC 108—Falk Corp., Milwaukee 8, has released engineering bulletin 3110 illustrating and describing its new all-steel right angle "Motoreducer" which is designed to combine the advantages of the company's standard gearmotor with an adaptable right angle head. The unit can be used for either horizontal or vertical applications and is available with either a single or double ended output shaft. It is furnished in either the integral type or the company's exclusive all-motor type; the latter being designed for any foot mounted motor. The minimum speed ratio is 5 to 1 and the maximum is 972 to 1. The approximate horsepower range is 1 to 50.

Glass Fiber Bibliography

HPAC 109—The third edition of the "Fiberglas" Bibliography, a volume of annotated references to selected articles which have appeared in the nation's press, is now available from Owens-Corning Fiberglas Corp., 1911 Nicholas Bldg., Toledo 1. The 88 page paper covered booklet contains indexes of publications cited, authors, applications and uses. It lists 710 references to articles in 338 publications and is available without charge to engineers, technologists, research investigators, and college and university students on request to the company's public relations director.

Hot Water Heating Controls

HPAC 110—Hot water heating control bulletin F-3157-1 of Barber-Colman Co., Rockford, Ill., provides comprehensive design data for the selection of automatic temperature controls. Data include schematic operation diagrams, descriptions, and basic wiring information.

Liquid Rheostat

HPAC 111—Construction and operating features of its liquid rheostat, type 257, which is designed to provide stepless, wide range speed control of wound rotor motors, are described in a new leaflet (No. 11S7544) released by Allis-Chalmers Mfg. Co., 1171 S. 70th St., Milwaukee. The device is especially recommended for variable torque loads such as induced and forced draft fan drives, centrifugal pumps, blower and compressor drives, etc.

Listing of Electric Service Shops

HPAC 112—Service Bulletin A-2025, published by Reliance Electric & Engineering Co., 1088 Ivanhoe Rd., Cleveland 10, contains up-to-date information on the authorized service shops of the company. Some 83 service shops, located in 31 states, are listed in the four page folder which also gives the complete address, telephone number, and name of the man in charge of each shop.

Materials Selection Chart

HPAC 113—Cooper Alloy Foundry Co., Hillside, N. J., has published a four page materials selection chart pre-

CLIFF STEEL HEAVY DUTY HEATING BOILERS

- Heavy duty long life water leg construction. ✓
- Well constructed heavy flue doors and fire doors. ✓
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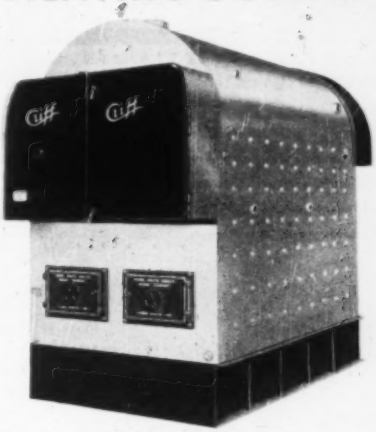
- May be furnished in any size with an enameled steel jacket with two inch fibre-glass insulation. ✓



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Airsan expanded metal face plate acts as a lint arrestor to provide easier cleaning and servicing and distributes air evenly over entire filtering area, providing high filtering efficiency and dust holding capacity with low resistance. Other features include all galvanized construction and full bronze welded corners.

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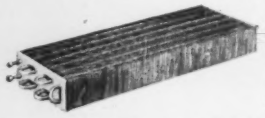
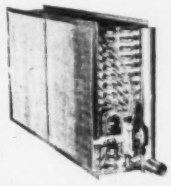
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AUTOMATIC
CEILING SHUTTER
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Built so they can be installed practically flush with the ceiling, AIR-FLO Ceiling Shutters present a refined, finished appearance. Their natural aluminum color blends with any decoration, eliminating need for painting, and no grille or winter cover is required. Furnished in 5 different widths, single panel up to 73" long. No operating mechanism shown. Built in fusible link. Meets fire underwriters requirements.
WRITE FOR NEW CATALOG 43-D
Illustrations and details of the complete AIR-FLO line.
AIR CONDITIONING PRODUCTS CO.
2340 W. LAFAYETTE BLVD. • DETROIT 16, MICH.

pared by Norman S. Mott, chief chemist and metallurgist. Carbon steel, along with a number of the company's alloys are listed in table headings, appearing in the order of increasing cost from left to right, so that for any of 350 different corrosive conditions the most economical material may be readily selected.

Motor Starters

HPAC 114—Type H motor starters (for 2300 to 5000 volt squirrel cage, wound rotor, synchronous and multi-speed motors) are described in a new 12 page bulletin (14B6410A) of Allis-Chalmers Mfg. Co., 1171 S. 70th St., Milwaukee. The starters are built for full voltage or reduced voltage, reversing or nonreversing, with plugging, dynamic breaking and multi-speed features. Ratings are up to 2500 hp at 5000 volts. The company's air brake contactor, type 256, which is recommended for applications requiring frequent starting, inching, reversing, plugging, or dynamic braking, is described in Bulletin 14B7303.

Operation of Inaccessible Valves

HPAC 115—A new folder on its adjustable sprocket rim with chain guide has been issued by Babbit Steam Specialty Co., New Bedford, Mass. The equipment is designed for operation of overhead or inaccessible valves and hopper devices from the floor. According to the manufacturer, the sprocket rims are attached to valve hand wheels in a few minutes. The chain fits over the individual sprockets of the rim and a chain guide arm is used to prevent the chain from slipping off the rim.

Pressure Regulator and Pump Governor

HPAC 116—Bulletin No. 102 of C. E. Squires Co., 18502 Syracuse Ave., Cleveland 10, covers the class H pressure regulator and pump governor. The valve is said to be extremely simple in design and well suited to installations where the close regulation of a pilot operated valve is not necessary. It may also be used as a pump governor and may be furnished with a packless stem.

Protective Coatings

HPAC 117—"Chlorclad" M-4 and W-6 are formulations of synthetic rubber coatings, M-4 being compounded for use on metal and concrete under corrosive conditions and W-6 being compounded for use on wood subjected to continual immersion in water or for very moist conditions. Advantages, corrosion resistance, application, and prices are covered in a new data sheet (No. C-21) issued by Carboline Co., 7603 Forsyth Blvd., St. Louis 5. Another new bulletin (No. C-51) covers the advantages, limitations, corrosion resistance, uses, applications and costs of a modified phenol formaldehyde resin that requires no baking to obtain maximum hardness and corrosion resistance. Called "Phenoline", the material can be used for lining unjacketed tanks, for hydrochloric acid and solvent storage tanks, in connection with beer storage, food processing, etc.

Protective Coatings

HPAC 118—Phosphate coating chemicals and processes for paint bonding, rustproofing, protecting friction surfaces, and improving drawing and extrusion are described in a new 12 page booklet issued by American Chemical Paint Co., Ambler, Pa. Identified as technical service

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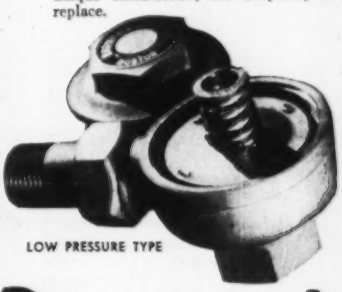

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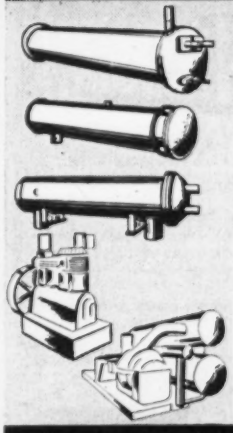

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AURORA Always PUMPS

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The new *CALIBRATED DIAL* now available on Leslie Class T and Class M Temperature Regulators provides quick, easy and dependable temperature settings.

Features

★ **TIME SAVING**—*Just turn the dial to the desired setting—no waiting for equipment to heat up to find out if setting is correct.*

★ **SAFE**—*Avoids costly overheating caused by guess setting.*

★ **RUGGED**—*Designed for production line use where frequent dependable readjustments are necessary.*

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PRESSURE REDUCING VALVES • PRESSURE CONTROLLERS
FLOATLESS LEVEL CONTROLS • PUMP GOVERNORS
TEMPERATURE REGULATORS • SELF CLEANING STRAINERS
AIR HORNS • STEAM WHISTLES

data sheet No. P-100-46, the bulletin covers various applications.

Pump Drives for Turbine Pumps

HPAC 119—Descriptions of right angle geared pump drives and their application to vertical turbine pumps is the subject of a new bulletin issued by Peerless Pump Div., Food Machinery and Chemical Corp., 301 West Ave., 26, Los Angeles 31. These "Gearturbo" pump heads are described in Bulletin B-140-1 and are recommended for applications where electricity is not available, where natural gas, gasoline, diesel or steam power is more economical, or where the added security of standby power is desired in case of electrical power failure. The heads are offered in nine sizes, with horsepower ratings from 3 to 300.

Pumps

HPAC 120—Pumps for handling corrosive and noncorrosive liquids, solids-carrying liquids and dry and semi-dry materials are covered in a new condensed catalog issued by Yeomans Brothers Co., 1433 N. Dayton St., Chicago 22. In the section on corrosive and noncorrosive liquids the bulletin covers vertical submerged centrifugal pumps and horizontal end-suction circulating pumps. For solids-carrying liquids, horizontal and vertical nonclog centrifugal pumps are covered and the application, operation and advantages of the "Shone" pneumatic unit are given. For dry and semi-dry materials, suggested applications and the operation of the company's "Transporter" are given. Copies of the catalog may be obtained directly from the manufacturer by forwarding requests on company letterheads.

Refractory Tile Boiler Seam Protector

HPAC 121—National Boiler Protector Co., 928 Ribold Bldg., Dayton 2, Ohio, has published a new circular on its seam protector, a refractory tile attachable in sets by means of bolts and hangers to the seams of riveted, horizontal return tubular boilers so as to insulate the lapped edges of the plates from fire-cracking and oxidation. The manufacturer states that the protectors make further calking unnecessary, avoid plate deterioration, and avert the hazard of explosion due to seam failure.

Refrigeration and Air Conditioning

HPAC 122—Frigidaire Div., General Motors Corp., Dayton 1, Ohio, has prepared a new folder on its refrigeration and air conditioning equipment for industrial use. The leaflet does not go into technical details, but has been prepared as a "thought starter" in connection with production short cuts and increased manufacturing efficiency.

Silver Brazing Alloys

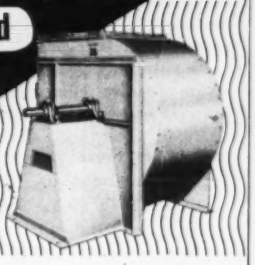
HPAC 123—Handy & Harman, 82 Fulton St., New York 7, has released a new bulletin covering silver alloy brazing with "Easy-Flo" and "Sil-Fos". It tells where and how to use these alloys to the best advantage, shows many applications, and describes brazing techniques.

Speed Reducers

HPAC 124—Falk Corp., Milwaukee 8, Wis., has released four new engineering bulletins illustrating and describing its improved parallel shaft speed reducer and

MASSACHUSETTS

Squirrel Cage and Power Fixed FANS



SQUIRREL CAGE FANS

Fan wheels have low speed characteristics. The low air velocities permitted are conducive to efficient operation. Housings are rugged and compact. Wheel sizes Single Width 13½" to 86½" dia. Double width 18" to 86½" dia.

POWER FIXED FANS

Backward curve blade type with non-overloading characteristics. Housings are constructed of steel plate and reinforced with heavy bracing angles. Wheel sizes Single Width 13½" to 86½" dia. Double Width 18" to 86½" dia. Class I or Class II construction for better fan selection.

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Write for Catalogs No. 12-B and 1312-B

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It's a "best buy" with the exclusive *Chrome-Clad* finish that's non-glare, rust resistant. Black markings stand out razor-sharp against the chrome white background.

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- Satin finish will not crack, chip, or peel.
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The Type NWDH dual switch thermostat with remote bulb for duct mounting is being used in applications in which it is desired to handle two electrical circuits from a single thermal assembly. Typical installations include the control of two compressors, one for normal operation and one for peak loads; or a fan and a compressor.

Standard switches are rated at 15 amps 125/250 V. AC. Switches rated at ¾ hp 125 V. AC, 1½ hp 250 V. AC are also available.

Whatever your control problem may be, United Electric Controls Co. is prepared to assist you. Send full details and drawings. Write for bulletin giving complete details on the control mentioned above.

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STANDARD & SPECIAL THERMOSTATS & PRESSURE SWITCHES

The Only Stub End with ALL THESE FEATURES

- Machine tool cut and beveled.
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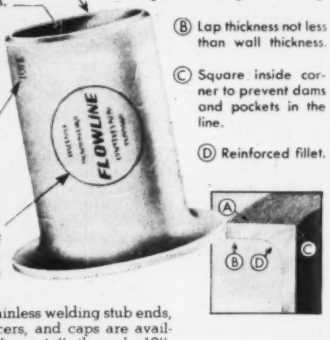
- Formed cold by exclusive Welding Fittings process.
- Heat number permanently stamped as record of actual analysis and physical properties.
- Annealed, cleaned bright and passivated.
- Trade mark, type of material, size, schedule, wall thickness marked.

Ⓐ Serrated face for improved gasket holding and seating.

Ⓑ Lap thickness not less than wall thickness.

Ⓒ Square inside corner to prevent dams and pockets in the line.

Ⓓ Reinforced fillet.



FLOWLINE stainless welding stub ends, tees, ells, reducers, and caps are available in sizes from ½" through 12". 2846 stock items—see Bulletin S-310.

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its right angle speed reducer (both horizontal and vertical). Standard units feature herringbone double helical gears and are available with sleeve bearings or roller bearings. The right angle speed reducers are furnished with spiral bevel helical gears, and the vertical right angle units are equipped with a patented oil pump designed to assure positive lubrication at all times. Approximate horsepower range of these units is from 15 to 2000.

Steam Condensers, Centrifuges, Ejectors

HPAC 125—Condenser Service & Engineering Co., Inc., Seaboard Trust Bldg., Hoboken, N. J., has issued three new catalogs. Bulletin 102 describes and illustrates a few recent power plant condenser installations. Also featured is an engineering section, a maintenance section and descriptions of air removal equipment and condenser specialties. An eight page bulletin on the CME continuous centrifuge describes and illustrates both screen type and solid bowl type units which are recommended for dewatering, classifying, fractionating, degritting, thickening, and extracting. Also covered is a continuous demulsifier. The "Blackburn-Smith" pneumatic sewage ejector system is described in bulletin S-50, which features a number of piping diagrams.

Steam Generator

HPAC 126—Foster-Wheeler Corp., 165 Broadway, New York 6, points out the advantages of its dual circulation steam generator in a new booklet. In May, 1948, a unit of this type was placed in service at a large midwestern refinery and is said to have proved its ability to produce steam of unusual purity for modern conditions of high pressure and temperature.

Steam Generators, Oil and Gas Burners

HPAC 127—A new 160 page catalog has been prepared by Preferred Utilities Mfg. Corp., 1860 Broadway, New York City. It is a combination catalog and handbook and has three major sections. Some 28 pages are devoted to packaged steam generators, oil and gas burners, ranges, water heaters, ovens, etc. There are 98 pages on oil, gas and other accessories, such as "Draft-A-Justors", oil line accessories and controls, as well as 34 pages of useful data for designers and installers of oil and gas fired heating, hot water, and power plants. Copies are for sale and may be obtained from the manufacturer for $2.50.

Steam Traps

HPAC 128—The line of "Super-Silvertop" steam traps is described and illustrated in Bulletin No. 550 now available from V. D. Anderson Co., 1949 W. 96th St., Cleveland 2. This four page bulletin contains specifications, capacities, sizes, pressures, weights and list prices of all principal types. In addition, the design and construction advantages of these inverted bucket type traps are described. Data are also contained on the company's self-cleaning strainers and its steel series steam traps.

Synchronous Motor Starters

HPAC 129—A new eight page booklet (B-4379) describing "Slipsyn" synchronous motor control, for the operation and protection of all types of synchronous motor drives, is available from Westinghouse Electric Corp., Box

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PROTECT THAT MOTOR

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AGAINST OVERLOAD AND OVERHEATING..

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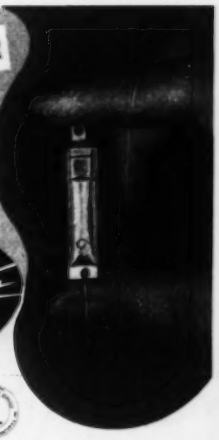
MIGHTY MITE THERMOSTAT



Specify Mighty Mite to stand effective guard over your product. *Enjoy these advantages*: pre-calibrated to your exact requirements, accurate control; small enough to insert in motor winding without alteration of housing, low installation cost; true dependability of operation, proved by a million installations; no rivets, eyelets, screws, solder, or fiber; dust-proof, moisture-proof, tamper-proof.

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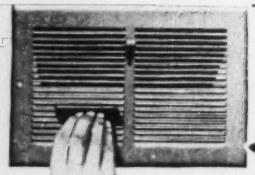

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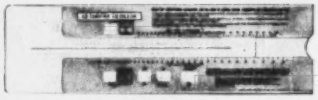
AIR-CONDITIONING CALCULATOR



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Many designs for all purposes—air conditioning, ventilating, radiator enclosure and concealment. Almost any sizes in steel, aluminum, brass or bronze. In selecting grilles, you will find Auer Grille Catalog "G" useful. It gives complete grille data, shows all Auer designs with dimensions, opening sizes and full scale details. Sent on request. Order Auer Grilles by name and number.

THE AUER REGISTER COMPANY
6600 Clement Ave. Cleveland 5, Ohio

2099, Pittsburgh 30. Photographs keyed to line drawings explain the operation of these starters and point out their features. The new type ASR polarized slip-frequency field application relay is pictured and its operation is described. The booklet also features a new pull-out relay which protects the motor in case it fails to synchronize or in case it pulls out of synchronization after being in step.

Temperature-Humidity Instruments

HPAC 130—Foxboro Co., Foxboro, Mass., has prepared a four page bulletin on its temperature-humidity instruments recommended for measuring the effectiveness of air conditioning. Described and illustrated are a wet and dry bulb recorder, a direct reading relative humidity and dry bulb recorder, and a dew point and dry bulb recorder.

Temperature and Pressure Regulators

HPAC 131—A new four page folder is available from Spence Engineering Co., Inc., Walden, N. Y., which gives information on the firm's temperature regulators, pressure regulators, and desuperheaters. An explanation of the principles of the company's pilot operated regulating valves is given, together with data and illustrations of 27 pilots.

Tubing of Two Different Metals

HPAC 132—For conditions where single walled tubing cannot withstand simultaneous attack from two entirely different types of corrosive media, Bridgeport Brass Co., Bridgeport 2, Conn., has developed "Duplex" tubing. It is made up of two different metals or alloys, inside and outside, each designed to withstand the particular corrosive medium with which it is in contact. For example, copper or brass may be used on the water side and steel on the ammonia side. Combinations include admiralty metal, aluminum brass, copper, copper-nickel, aluminum bronze, and silicon bronze, combined with steel, stainless, aluminum, monel, nickel, lead and tin, either inside or outside. Bulletin No. 1950 gives detailed information. Free copies of the bulletin may be obtained directly from the manufacturer by sending requests on company stationery.

Turning Rolls for Arc Welding

HPAC 133—The welding and assembly positioning equipment division of Worthington Pump and Machinery Corp., Dunellen, N. J., has issued a four page folder on its turning rolls which are recommended for use in connection with downhand arc welding of tanks or vessels. By pressing a remote pushbutton, the work is continuously rotated around to the welder, who can make all welds in the downhand position.

Warm Air Panel Heating

HPAC 134—The split system of warm air panel heating developed by Flexicore Co., Inc., P. O. Box 825, 1932 E. Monument Ave., Dayton 1, Ohio, utilizes precast concrete floor slabs having hollow cores. Warm air is passed from the supply duct through holes in the under side of each slab, flowing both ways to the ends of the slabs and then through holes in the top of each slab and into a baseboard plenum. The air then enters the room below window areas through an adjustable grille in the baseboard plenum. The air is returned to the warm air heating plant through a centrally located return grille. Detailed information is given in a six page folder.

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Classified Section: Rates for classified advertising are 10 cents for each word, including heading and address. One inch $5.00. Count nine words for keyed address. Minimum $2.00 for each insertion. Cash must accompany order.

agents wanted

WANTED — A.S.H.V.E. members or Registered Engineers as associates for representation in following areas: Rochester, N. Y., Baltimore, Boston, Wilmington, Del., and Southern part of N. J. Thermas controls. Air mail replies. Address Key 2884-A, Heating, Piping & Air Conditioning, 6 No. Michigan Ave., Chicago 2.

for sale

FOR SALE — 2 Complete Kroeschell C O 2 Machines — size 8"x16" — double acting, equipped with: 2 G.E. synchronous motors, 3 phase, direct connected, 440 volt, 60 cycle, 150 R.P.M., exciter voltage 125. 2 Motor generator sets 125 volts for synchronous motors. 3 Allis-Chalmers outdoor type transformers, single phase, 150 K.V.A., 60 cycle, 4600 volts to 460 volts. 2 G. E. starters for two synchronous motors. Address Crowley, Milner & Company, Maintenance Department, Detroit 26, Michigan.

situation wanted

HEATING, VENTILATING & AIR CONDITIONING ENGINEER University Graduate with fifteen years' experience in design and installation supervision of heaters, ventilating, air conditioning and plumbing work, presently employed in charge of design and supervision of large projects involving multi-story hotels and office buildings, desires a position with good future prospects. Preference given to South-west or Mid-west location. Address Key 2886-A, Heating, Piping & Air Conditioning, 6 No. Michigan Ave., Chicago 2.

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..... so why should you waste it by looking around for items or personnel to make your organization more efficient? A simple classified advertisement in Heating, Piping & Air Conditioning will turn the trick for you quickly and at low cost. No matter what you need or have to sell one of our readers will have it or want it. The same goes for personnel and miscellaneous items, too. Rates are shown at the top of the page—closing date is the fifteenth of the month preceding issue.

Let's hear from you!

situations open

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Copper Refrigeration Coil 5/8" Copper tubing .049 wall, hot tin dipped. 1-1/8" overall diameter 1/4" fin., thickness .022, — 6, 7 & 8 foot lengths manufactured by Rome Turney, Rome, N. Y. Delivery immediate, quantity 132,440 lbs. 16 inches to a lb. Zinc Trading Company, 244 Riverside Drive, New York 25, N. Y. Cable:—Zinctracon N.Y. Phone Monument 6-3433.

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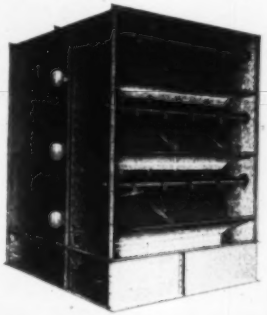
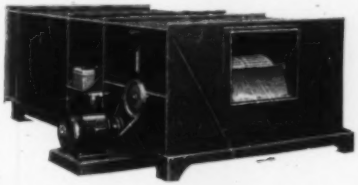


AIR WASHERS
AND PURIFIERS



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FOR nearly 40 years — *through constant product improvement* — Clarage has maintained leadership in this specialized field . . . Directing your air handling and conditioning requirements our way is to place them in capable hands . . .

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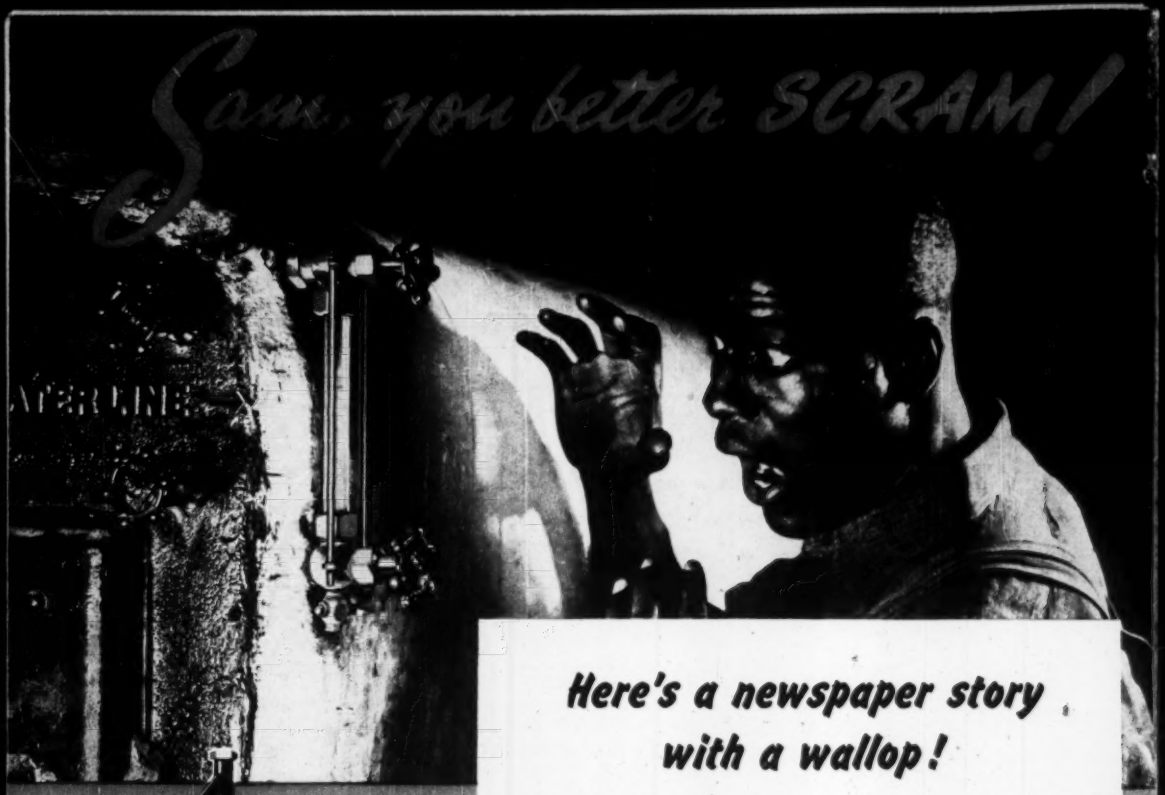


Here's a newspaper story with a wallop!

Under the heading, "Heating Plants, Like Automobiles, Need Overhauling," the June 16 La Crosse, Wis., Tribune says in part:

"Suppose you drove your automobile 40 miles per hour, 24 hours a day, from the first of October to the first of May. That would amount to some 200,000 miles.

"You would agree that, after such a strenuous work-out, the car would be due for a thorough inspection and overhauling.

"That's about the situation your heating plant is facing at this time of year after a Winter's service . . . Yet while most owners of cars rush them to the service station at the first sign of a knock or squeak, the family heating plant is too often neglected."

Space limitations forbid quoting in full, but you can guess the rest of the article which goes on to drive home the fact that "Good service for the heating system will pay in increased 'mileage'" — that the boiler owner should call on the expert knowledge and experience of the contractor or dealer in checking boilers, burners and controls. The article appeared in a number of newspapers, having been sent out by your friend and ours, the Plumbing & Heating Industries Bureau.

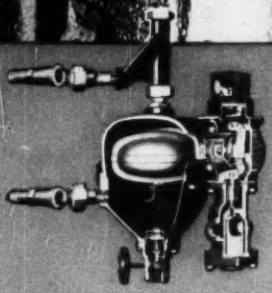
Yes, it's an article with a wallop: gospel truths, powerfully presented in down-to-earth terms of the petted family car — a comparison that should shame any thinking boiler owner into immediately turning his heating plant in for servicing.

We suggest you use this idea to wake up neglectful customers to the importance of caring for that all-essential heating boiler. And while you're at it you may want to show the owner why a boiler without McDonnell boiler water lever controls is about like an automobile without brakes or a steering gear.

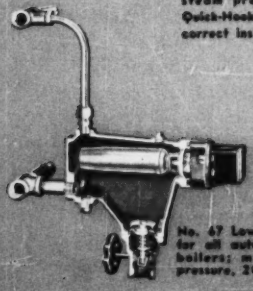
Leading McDonnell controls are described opposite. Ask for latest condensed catalog and price sheet covering full line.

McDONNELL & MILLER, INC.

3500 N. Spaulding Ave., Chicago 16, Ill.



No. 47-2 Feeder-Cut-off Combination for boilers below 5000 sq. ft.; maximum steam pressure, 25 lbs. Quick-Hook-Up for speedy, correct installation.



No. 67 Low Water Cut-off for all automatically fired boilers; maximum steam pressure, 20 lbs.

No. 150 Water Level Control for boilers of any size with steam pressures up to 150 lbs. Used as feed-pump control, low-water fuel cut-off, low water alarm switch, or any combination of these functions.

Doing One Thing Well

Hook Jobber Service Manual

McDONNELL

Boiler Water Level Controls